ID No.
AP – IECF30

# Instruction MANUAL

# SERIES 30 FUNCTION GENERATOR

IEC
A Subsidiary Of A-T-O Inc
INTERSTATE ELECTRONICS CORPORATION
Department 7000 707 EAST VERMONT AVENUE, ANAHEIM, CALIFORNIA 92803 • (714) 772-9011
(714) 687-5934

# Instruction MANUAL

Model No. _____ Serial No. _____

# SERIES 30 FUNCTION GENERATOR

INTERSTATE ELECTRONICS CORPORATION
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Department 7000 707 EAST VERMONT AVENUE, ANAHEIM, CALIFORNIA 92803 • (714) 772-2811

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PART NO. P00335099 REV E

## WARRANTY

Interstate Electronics Corporation warrants its function generators against defects in material and workmanship for a period of one year from date of shipment. We will repair or replace defective products during the warranty period provided that such defect developed under normal and proper use and that transportation costs are paid by the purchaser. We are not liable for consequential damages nor is any other warranty expressed or implied.

## RECEIVING AND INSPECTION

Immediately upon receipt of the instrument, inspect the exterior of the shipping container for physical damage and notify carrier if such damage is visible. After carefully removing all packing materials, inspect the instrument to ensure that it is free of mars and blemishes that may have occurred during shipment. If there is physical damage to the carton or the outside of the instrument, check the instrument functionally for internal damage before accepting the shipment.

## CLAIM FOR DAMAGED SHIPMENT

If damage has occurred, a claim should be made with the carrier. The claim agent should receive a complete report of damage.

## CALIBRATION AND REPAIR SERVICE

IEC maintains a trained staff of engineers and technicians for assisting customers in out-of-warranty service.

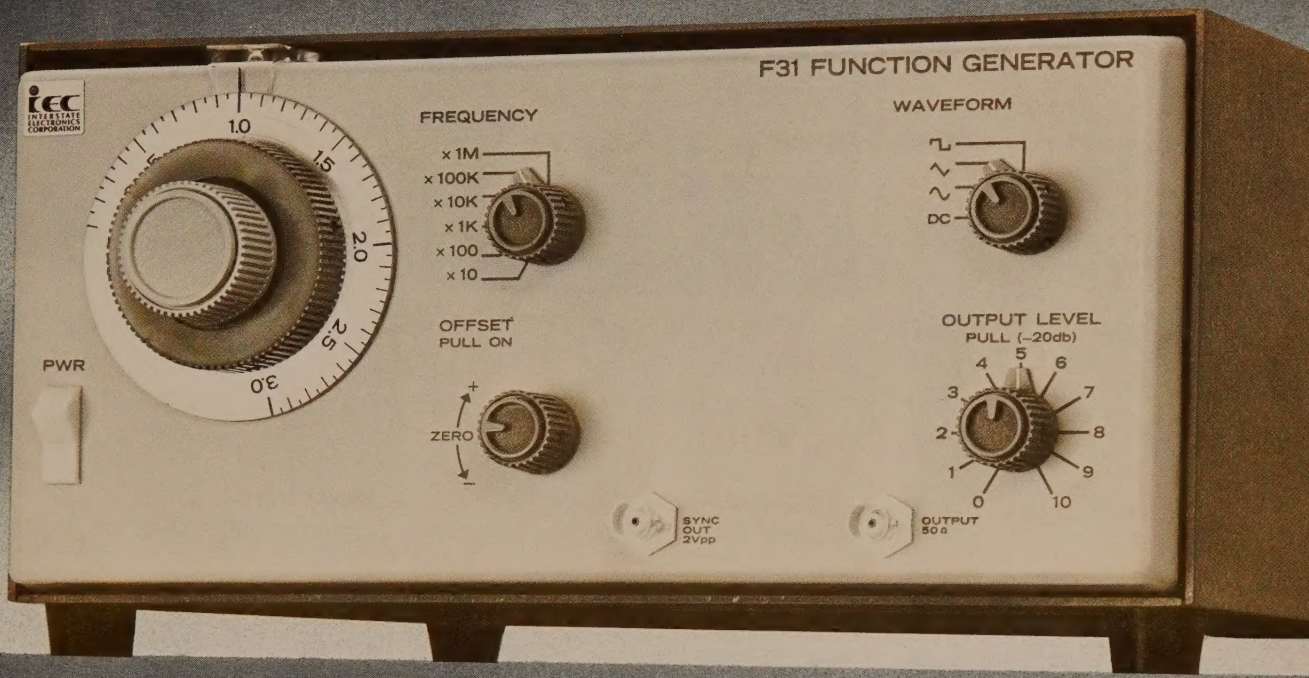
## POWER

This instrument operates from a-c power only, either 115 or 230 Vac, 50 to 400 Hz. A slide switch at the rear of the equipment readily selects the desired power line voltage. A NORMAL/LOW switch is provided for use with extremely low-line voltages (100 or 200 Vac ±10 percent).

**CAUTION**

Operation at the wrong power line voltage switch setting may damage the instrument or blow fuses.

# F31 FUNCTION GENERATOR

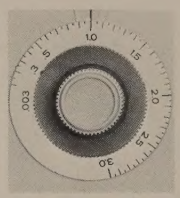



## WIDE — 0.03Hz to 3MHz — FREQUENCY RANGE

- Sine, square, triangle
- Adjustable d-c level
- ±5V offset into 50Ω
- 2-step, 40-db attenuator

# F31

**IEC's inexpensive, versatile F31 function generator provides sine, square, and triangle waveforms in the 0.03Hz to 3MHz frequency range at levels up to 10V p-p into 50Ω. F31 offers these outstanding features at a budget price:**

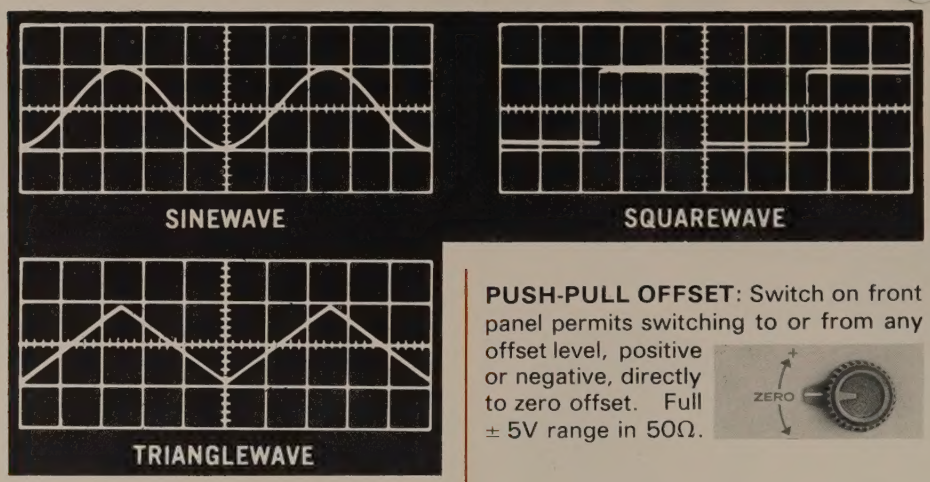


**CALIBRATED COARSE-FINE TUNE:** Operates over full 1000:1 manual tuning range. Smooth-acting planetary drive permits precise frequency setting with either coarse or fine tune verniers.

**2-STEP, 40-db ATTENUATOR:** For maximum resolution and signal-to-noise ratio, especially at low signal levels.

**PLUG-IN IC's:** On critical circuits, plus fully accessible components and adjustments for easy maintenance.

**ADJUSTABLE D-C LEVEL:** "Zero waveform" for tests requiring active source without a-c signal presence and as d-c source for d-c gain tests.




**PUSH-PULL OFFSET:** Switch on front panel permits switching to or from any offset level, positive or negative, directly to zero offset. Full ± 5V range in 50Ω.




## SPECIFICATIONS

### WAVEFORMS

**VARIABLE AMPLITUDE:** Sine, square, triangle, adjustable d-c level (no a-c waveform). All waveforms symmetrical about ground or may be offset. Output impedance is 50 Ω.

**FIXED AMPLITUDE:** Sync out. Squarewave, 2 v p-p minimum into open circuit, symmetrical about ground. Rise-fall times less than 50 nsec. Output impedance is 50 Ω.

### FREQUENCY

**RANGE:** 0.03 Hz to 3 MHz in six decade ranges with 1000:1 continuous course and fine vernier adjustment within any range.

**DIAL ACCURACY:** ±2% of full-scale.

**TIME SYMMETRY:** >99% to 1 MHz.

### AMPLITUDE

**MAXIMUM OUTPUT:** 20 v p-p into open circuit.

**ATTENUATOR:** Two steps, 0 and −20 db with additional 0 to 20 db continuous vernier; total range >40 db.

**SINE FLATNESS:** Better than ±0.5% 0.3 Hz to 300 kHz, better than ±2% on X1M range.

**SINE DISTORTION:** <0.3% on lowest four ranges; <0.5% on x100K range; <2% on X1M range.

**SQUAREWAVE:** Rise-fall times <60 nsec, <5% total aberration.

**TRIANGLE LINEARITY:** >99% between 3 Hz and 300 kHz.

### OFFSET

Continuously variable ±10 v into open circuit, push-pull selector. Total signal plus offset limited to ±10 volts independent of vernier control, attenuated proportionally with step attenuator.

### STABILITY

Frequency, amplitude, offset stability better than 0.05% for 10 minutes; 0.25% for 24 hours.

### ISOLATION

Detachable ground strap may be removed to electrically isolate all BNC connectors and circuit grounds from case and powerline ground. Maximum isolation is ±500 v.

### OPERATING TEMPERATURE

0° to 50°C.

### POWER

115 vac ±10% or 230 vac ±10%, 50-400 Hz, 25 w maximum.

### DIMENSIONS

11⅛" (28.2 CM) W x 5¼" (13.3 CM) H x 12¾" (32.3 CM) D.

### WEIGHT

11 lb. (5 kg) Net, 15 lb. (7 kg) shipping.

**NOTES:** Except where indicated, specifications apply with 25°C±5°C ambient; with 50Ω resistive load; 0 vdc offset; frequency controls set between 0.3 and 3 on the frequency dial; all external inputs removed and after 30-minute warm-up.

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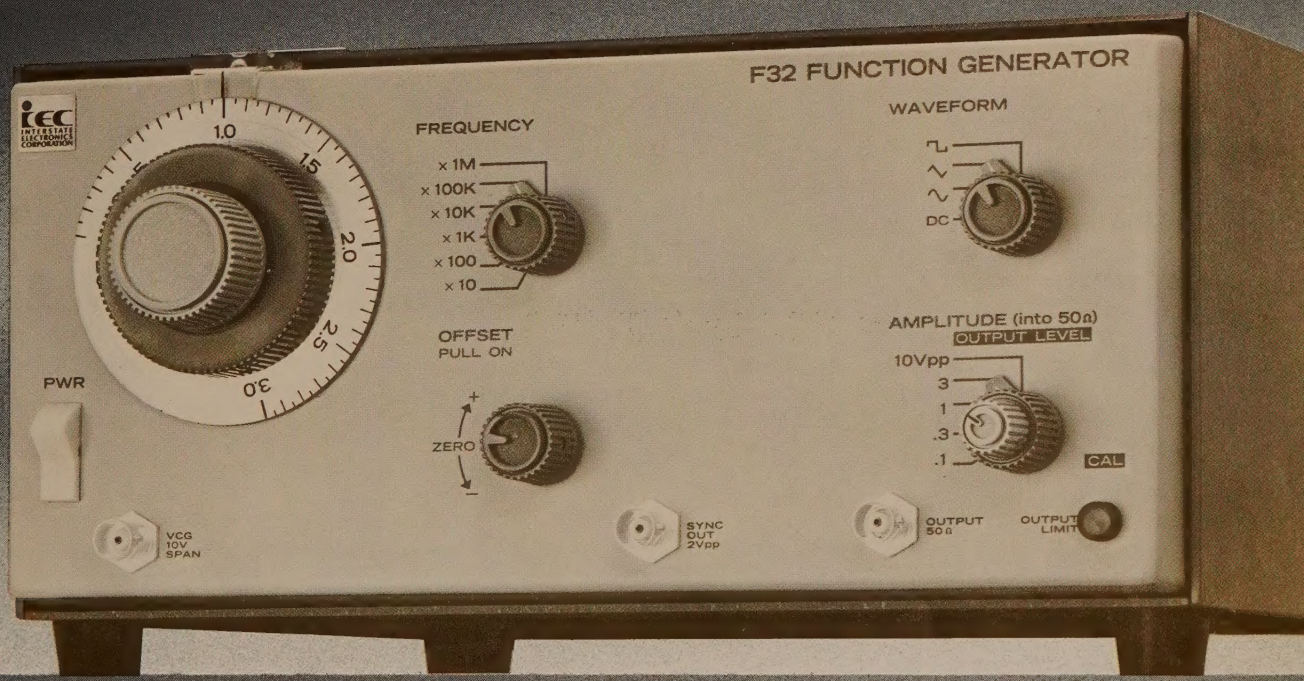
# F32 FUNCTION GENERATOR



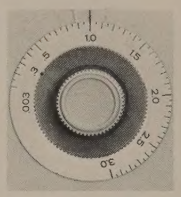

## WIDE — 0.03Hz to 3MHz — FREQUENCY RANGE

- 5-step, 60-db attenuator
- 1000:1 VCG
- Output limit indicator
- Sine, square, triangle
- Adjustable d-c level
- ±5V offset into 50Ω

# F32

**IEC's inexpensive, versatile F32 function generator provides sine, square, and triangle waveforms in the 0.03Hz to 3MHz frequency range at levels up to 10V p-p into 50Ω. F32 offers these outstanding features at a budget price:**

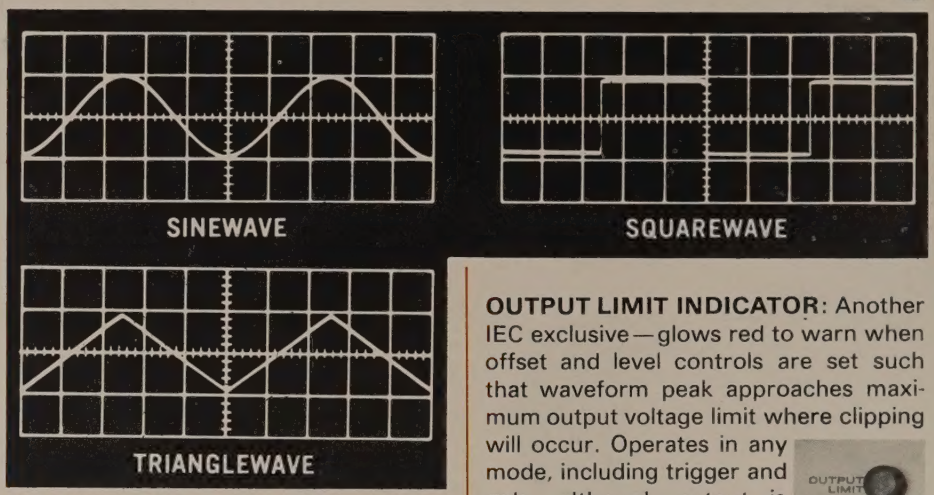
**CALIBRATED COARSE-FINE TUNE:** Operates over full 1000:1 manual tuning range. Smooth-acting planetary drive permits precise frequency setting with either coarse or fine tune verniers.



**5-STEP, 60-db ATTENUATOR:** For maximum resolution and signal-to-noise ratio, especially at low signal levels.

**PLUG-IN IC's:** On critical circuits, plus fully accessible components and adjustments for easy maintenance.

**PUSH-PULL OFFSET:** Switch on front panel permits switching to or from any offset level, positive or negative, directly to zero offset. Full ±5V range in 50Ω.




**ADJUSTABLE D-C LEVEL:** "Zero waveform" for tests requiring active source without a-c signal presence and as d-c source for d-c gain tests.

**OUTPUT LIMIT INDICATOR:** Another IEC exclusive—glows red to warn when offset and level controls are set such that waveform peak approaches maximum output voltage limit where clipping will occur. Operates in any mode, including trigger and gate although output is only on during trigger or gate interval.

## SPECIFICATIONS

### WAVEFORMS

**VARIABLE AMPLITUDE:** Sine, square, triangle, adjustable d-c level (no a-c waveform). All waveforms symmetrical about ground or may be offset. Output impedance is 50 Ω.

**FIXED AMPLITUDE:** Sync out. Squarewave, 2 v p-p minimum into open circuit, symmetrical about ground. Rise-fall times less than 50 nsec. Output impedance is 50 Ω.

### FREQUENCY

**RANGE:** 0.03 Hz to 3 MHz in six decade ranges with 1000:1 continuous course and fine vernier adjustment within any range.
**DIAL ACCURACY:** ±2% of full scale.

**TIME SYMMETRY:** >99% to 1 MHz.

### AMPLITUDE

**MAXIMUM OUTPUT:** 20 v p-p into open circuit.
**ATTENUATOR:** 0 to −40 db in 10-db steps; with additional 0 to 20 db continuous vernier; total range >60 db.

**SINE FLATNESS:** Better than ±0.5% 0.3 Hz to 300 kHz; better than ±2% on X1M range.

**SINE DISTORTION:** <0.3% on lowest four ranges; <0.5% on x100K range; <2% on X1M range.

**SQUAREWAVE:** Rise-fall times <60 nsec, <5% total aberration.

**TRIANGLE LINEARITY:** >99% between 3 Hz and 300 kHz.

### OFFSET

Continuously variable ±10 v into open circuit, push-pull selector. Total signal plus offset limited to ±10 volts independent of vernier control, attenuated proportionally with step attenuator.

### OUTPUT LIMIT INDICATOR

Glows when any combination of signal plus offset level settings approach maximum operating swing of generator output amplifier independent of waveform or mode selected.

### STABILITY

Frequency, amplitude, offset stability better than 0.05% for 10 minutes; 0.25% for 24 hours.

### VCG

External d-c or a-c voltage control of output frequency; 0 to +10 v change at VCG input changes output frequency upward 1000:1 from minimum dial setting; 0 to −10 v changes output frequency downward 1000:1 from maximum setting; within any multiplier range. Linear to within 0.25%. Bandwidth is 100 kHz, limited to 0.3 v/μsec. Input impedance is >10 kΩ.

### ISOLATION

Detachable ground strap may be removed to electrically isolate all BNC connectors and circuit grounds from case and powerline ground. Maximum isolation is ±500 v.

### OPERATING TEMPERATURE

0° to 50°C.

### POWER

115 vac ±10% or 230 vac ±10%, 50-400 Hz, 25 w maximum.

### DIMENSIONS

11⅛" (28.2 CM) W x 5¼" (13.3 CM) H x 12¾" (32.3 CM) D.

### WEIGHT

11 lb. (5 kg) Net, 15 lb. (7 kg) shipping.

**NOTES:** Except where indicated, specifications apply with 25°C±5°C ambient; with 50Ω resistive load; 0 vdc offset; frequency controls set between 0.3 and 3 on the frequency dial; all external inputs removed and after 30-minute warm-up.

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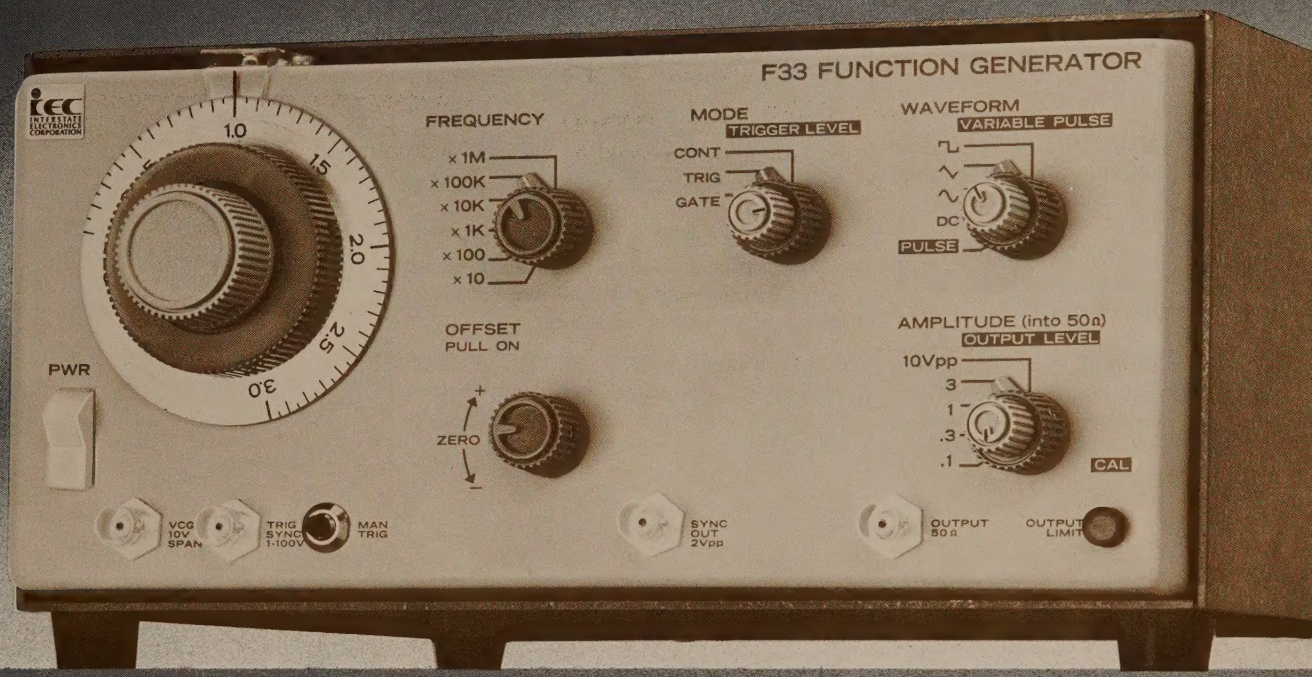
# F33 FUNCTION GENERATOR



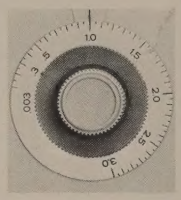

## WIDE—0.03Hz to 3MHz—FREQUENCY RANGE

- Variable width pulse
- Trigger & gate modes
- External synchronization
- 5-step, 60-db attenuator
- 1000:1 VCG
- Output limit indicator
- Sine, square, triangle
- Adjustable d-c level
- ±5V offset into 50Ω

# F33

**IEC's inexpensive, versatile F33 function generator provides sine, square, and triangle waveforms in the 0.03Hz to 3MHz frequency range at levels up to 10V p-p into 50Ω. F33 offers these outstanding features at a budget price:**

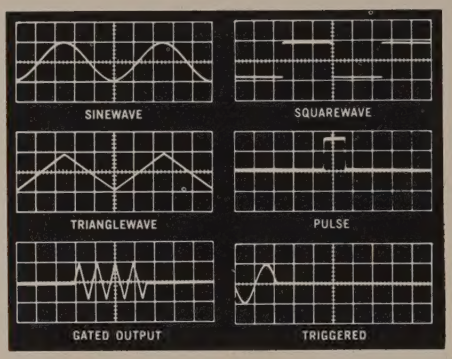
**CALIBRATED COARSE-FINE TUNE:** Operates over full 1000:1 manual tuning range. Smooth-acting planetary drive permits precise frequency setting with either coarse or fine tune verniers.



**5-STEP, 60-db ATTENUATOR:** For maximum resolution and signal-to-noise ratio, especially at low signal levels.

**PLUG-IN IC's:** On critical circuits, plus fully accessible components and adjustments for easy maintenance.

**PUSH-PULL OFFSET:** Switch on front panel permits switching to or from any offset level, positive or negative, directly to zero offset. Full ±5V range in 50Ω.

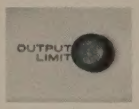



**VARIABLE WIDTH PULSE:** In addition to sine, square, and triangle output functions. Permits use in both waveform and pulse generator applications.

**ADJUSTABLE D-C LEVEL:** "Zero waveform" for tests requiring active source without a-c signal presence and as d-c source for d-c gain tests.

**EXTERNAL SYNCHRONIZATION:** Of output frequency with external reference for tests requiring coherent signals, for modifying waveforms of precision reference to sine, square, triangle, or pulse. Synchronizes to fundamental, multiple, or submultiple of reference frequency.

**OUTPUT LIMIT INDICATOR:** Another IEC exclusive—glows red to warn when offset and level controls are set such that waveform peak approaches maximum output voltage limit where clipping will occur. Operates in any mode, including trigger and gate although output is only on during trigger or gate interval.




## SPECIFICATIONS

### WAVEFORMS

**VARIABLE AMPLITUDE:** Sine, square, triangle, adjustable d-c level (no a-c waveform), variable duty cycle pulse variable 5 to 95% of full duty cycle (135 nsec minimum). All waveforms, symmetrical about ground or may be offset. Output impedance is 50 Ω.
**FIXED AMPLITUDE:** Sync out. Squarewave, 2 v p-p minimum into open circuit, symmetrical about ground. Rise-fall times less than 50 nsec. Output impedance is 50 Ω.

### FREQUENCY

**RANGE:** 0.03 Hz to 3 MHz in six decade ranges with 1000:1 continuous course and fine vernier adjustment within any range.
**DIAL ACCURACY:** ±2% of full scale.
**TIME SYMMETRY:** >99% to 1 MHz.

### AMPLITUDE

**MAXIMUM OUTPUT:** 20 v p-p into open circuit.
**ATTENUATOR:** 0 to −40 db in 10-db steps; with additional 0 to 20 db continuous vernier; total range >60 db.
**SINE FLATNESS:** Better than ±0.5% 0.3 Hz to 300 kHz; better than ±2% on X1M range.
**SINE DISTORTION:** <0.3% on lowest four ranges; <0.5% on x100K range; <2% on X1M range.
**SQUAREWAVE AND PULSE:** Rise-fall times <60 nsec, <5% total aberration.
**TRIANGLE LINEARITY:** >99% between 3 Hz and 300 kHz.

### OFFSET

Continuously variable ±10 v into open circuit, push-pull selector. Total signal plus offset limited to ±10 v independent of vernier control, attenuated proportionally with step attenuator.

### OUTPUT LIMIT INDICATOR

Glows when any combination of signal plus offset level settings approach maximum operating swing of generator output amplifier independent of waveform or mode selected.

### STABILITY

Frequency, amplitude, offset stability better than 0.05% for 10 minutes, 0.25% for 24 hours.

### VCG

External d-c or a-c voltage control of output frequency; 0 to +10 v change at VCG input changes output frequency upward 1000:1 from minimum dial setting; 0 to −10 v changes output frequency downward 1000:1 from maximum dial setting; within any multiplier range. Linear to within 0.25%. Bandwidth is 100 kHz, limited to 0.3 v/μsec. Input impedance is >10 kΩ.

### EXTERNALLY SYNCHRONIZED

Output frequency can be synchronized to external periodic reference signal >3 v p-p (100 v p-p max) applied to Trigger/Sync input when generator is tuned within 1% of reference frequency. Input impedance is 5 kΩ.

### MODES

**CONTINUOUS:** Operates as standard Function Generator with frequency determined by frequency control settings in parallel with VCG input.
**TRIGGER:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at Trigger/Sync input initiates one complete waveform cycle. Trigger Level control determines any triggering point on input waveform. Input impedance is 10 kΩ.
**GATE:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at the Trigger/Sync input gates main generator output on for the duration of the gate signal with last cycle completed after gate is removed.

### ISOLATION

Detachable ground strap may be removed to electrically isolate all BNC connectors and circuit grounds from case and powerline ground. Maximum isolation is ±500 v.

### OPERATING TEMPERATURE

0° to 50°C.

### POWER

115 vac ±10% or 230 vac ±10%, 50-400 Hz, 25 w maximum.

### DIMENSIONS

11⅛" (28.2 CM) W x 5¼" (13.3 CM) H x 12¾" (32.3 CM) D.

### WEIGHT

11 lb. (5 kg) Net, 15 lb. (7 kg) shipping.

**NOTES:** Except where indicated, specifications apply with 25°C±5°C ambient; with 50Ω resistive load; 0 vdc offset; frequency controls set between 0.3 and 3 on the frequency dial; all external inputs removed and after 30-minute warm-up.

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# F34 FUNCTION GENERATOR

## WIDE — 0.03Hz to 3MHz — FREQUENCY RANGE

- Sweep, continuous & triggered
- Direct-reading sweep limit
- Burst
- Analog of frequency out
- Variable width pulse
- Trigger & gate modes
- External synchronization
- 5-step, 60-db attenuator
- 1000:1 VCG
- Output limit indicator
- Sine, square, triangle
- Adjustable d-c level
- ±5V offset into 50Ω

**F34** **IEC's inexpensive, versatile F34 function generator provides sine, square, and triangle waveforms in the 0.03Hz to 3MHz frequency range at levels up to 10V p-p into 50Ω. F34 offers these outstanding features at a budget price:**

**CALIBRATED COARSE-FINE TUNE:** Operates over full 1000:1 manual tuning range. Smooth-acting planetary drive permits precise frequency setting with either coarse or fine tune verniers.

**DIRECT-READING SWEEP LIMIT:** An IEC exclusive—for easy set up of sweep width limits, eliminates need for calculations, scopes, or other instruments in setting sweep width limits.

**ANALOG OF FREQUENCY:** Voltage output directly proportional to operation frequency for driving x-y plotters and other displays. Output is present in any mode of operation.

**5-STEP, 60-db ATTENUATOR:** For maximum resolution and signal-to-noise ratio, especially at low signal levels.

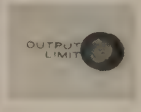
**PUSH-PULL OFFSET:** Switch on front panel permits switching to or from any offset level, positive or negative, directly to zero offset. Full ±5V range in 50Ω.

**VARIABLE WIDTH PULSE:** In addition to sine, square, and triangle output functions. Permits use in both waveform and pulse generator applications.

**ADJUSTABLE D-C LEVEL:** "Zero waveform" for tests requiring active source without a-c signal presence and as d-c source for d-c gain tests.

**EXTERNAL SYNCHRONIZATION:** Of output frequency with external reference for tests requiring coherent signals, for modifying waveforms of precision reference to sine, square, triangle, or pulse. Synchronizes to fundamental, multiple, or submultiple of reference frequency.

**OUTPUT LIMIT INDICATOR:** Another IEC exclusive—glows red to warn when offset and level controls are set such that waveform peak approaches maximum output voltage limit where clipping will occur. Operates in any mode, including trigger and gate although output is only on during trigger or gate interval.




**PLUG-IN IC's:** On critical circuits, plus fully accessible components and adjustments for easy maintenance.

## SPECIFICATIONS

### WAVEFORMS

**VARIABLE AMPLITUDE:** Sine, square, triangle, adjustable d-c level (no a-c waveform), sweep sawtooth, variable duty cycle pulse variable 5 to 95% of full duty cycle (135 ns. minimum). All waveforms, except sweep sawtooth, symmetrical about ground. Sweep is 0 vdc based negative going. All waveforms may be offset. Output impedance is 50 Ω.

**FIXED AMPLITUDE:** Sync out. Squarewave, 2 v p-p minimum into open circuit, symmetrical about ground. Rise-fall times less than 50 nsec. Output impedance is 50 Ω. Sweep Monitor/Sync. Ramp, 0 to +3 v minimum into open circuit. Output impedance is 600 Ω.

**FREQUENCY ANALOG:** D-C voltage proportional to output frequency on any multiplier range; 0 to +5 volts ±10%, linear to within 0.25%; output impedance is 600 Ω.

### FREQUENCY

**RANGE:** 0.03 Hz to 3 MHz in six decade ranges with 1000:1 continuous course and fine vernier adjustment within any range.

**DIAL ACCURACY:** ±2% of full scale.

**TIME SYMMETRY:** >99% to 1 MHz.

**SWEEP SAWTOOTH:** 0.01 Hz to approx. 90 kHz.

### AMPLITUDE

**MAXIMUM OUTPUT:** 20 v p-p into open circuit; sweep sawtooth to 10 v p-p into open circuit negative going.

**ATTENUATOR:** 0 to −40 db in 10-db steps; with additional 0 to 20 db continuous vernier; total range >60 db.

**SINE FLATNESS:** Better than ±0.5% 0.3 Hz to 300 kHz; better than ±2% on X1M range.

**SINE DISTORTION:** <0.3% on lowest four ranges; <0.5% on x100K range; <2% on X1M range.

**SQUAREWAVE AND PULSE:** Rise-fall times <60 nsec, <5% total aberration.

**TRIANGLE LINEARITY:** >99% between 3 Hz and 300 kHz.

### OFFSET

Continuously variable ±10 v into open circuit, push-pull selector. Total signal plus offset limited to ±10 v independent of vernier control, attenuated proportionally with step attenuator.

### OUTPUT LIMIT INDICATOR

Glows when any combination of signal plus offset level settings approach maximum operating swing of generator output amplifier independent of waveform or mode selected.

### STABILITY

Frequency, amplitude, offset stability better than 0.05% for 10 minutes, 0.25% for 24 hours.

### VCG

External d-c or a-c voltage control of output frequency; 0 to +10 v change at VCG input changes output frequency upward 1000:1 from minimum dial setting; 0 to −10 v changes output frequency downward 1000:1 from maximum dial setting; within any multiplier range. Linear to within 0.25%. Bandwidth is 100 kHz, limited to 0.3 v/μsec. Input impedance is >10 kΩ.

### EXTERNALLY SYNCHRONIZED

Output frequency can be synchronized to external periodic reference signal >3 v p-p (100 v p-p max) applied to Trigger/Sync input when generator is tuned within 1% of reference frequency. Input impedance is 5 kΩ.

### MODES

**CONTINUOUS:** Operates as standard Function Generator with frequency determined by frequency control settings in parallel with VCG input.

**SWEEP: Continuous Sweep:** Linearly sweeps the main generator upward between limits set with main frequency dial and Sweep Limit cursor. Maximum sweep range is 1000:1. Sweep Time control with six decade ranges and 100:1 continuous vernier provides sweep durations from 10 μsec to 100 sec.

**Triggered Sweep:** Manual or external command >±1 v (100 v max) initiates one sweep cycle. Main output is on only during sweep interval.

**BURST:** Integral number of main generator waveform cycles (as set with Trigger Level control) are repetitively triggered by internal sweep generator at rates up to 90k bursts/sec.

**TRIGGER:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at Trigger/Sync input initiates one complete waveform cycle. Trigger Level control determines any triggering point on input waveform. Input impedance is 10 kΩ.

**GATE:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at the Trigger/Sync input gates main generator output on for the duration of the gate signal with last cycle completed after gate is removed.

### ISOLATION

Detachable ground strap may be removed to electrically isolate all BNC connectors and circuit grounds from case and powerline ground. Maximum isolation is ±500 v.

### OPERATING TEMPERATURE

0° to 50°C.

### POWER

115 vac ±10% or 230 vac ±10%, 50-400 Hz, 25 w maximum.

### DIMENSIONS

11⅛" (28.2 CM) W x 5¼" (13.3 CM) H x 12¾" (32.3 CM) D.

### WEIGHT

11 lb. (5 kg) Net, 15 lb. (7 kg) shipping.

**NOTES:** Except where indicated, specifications apply with 25°C±5°C ambient; with 50Ω resistive load; 0 vdc offset; frequency controls set between 0.3 and 3 on the frequency dial; all external inputs removed and 30-minute warm-up.

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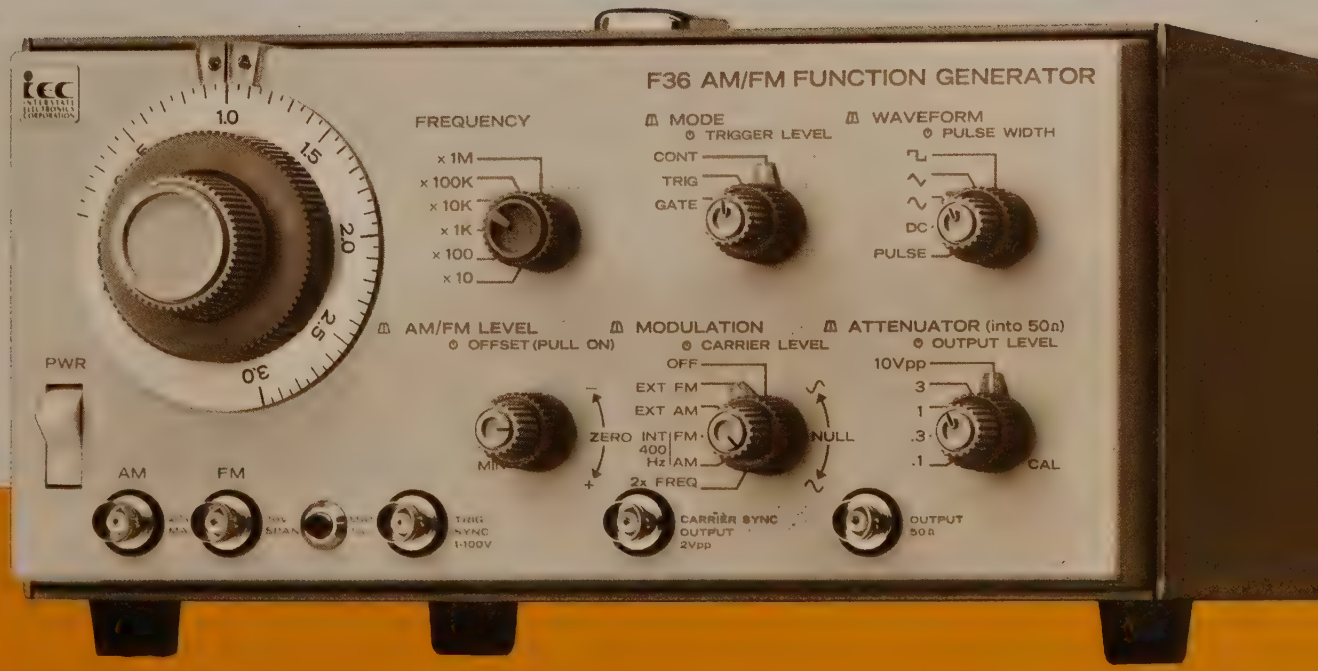
# F36 AM/FM FUNCTION GENERATOR

## WIDE — 0.03 Hz to 3 MHz — FREQUENCY RANGE

- AM, 40 db dynamic range
- FM, 1000:1
- Variable width pulse
- Trigger & gate modes
- External synchronization
- 5-step, 60-db attenuator
- Internal 400 Hz modulation
- Sine, square, triangle
- Adjustable d-c level
- ±5V offset into 50Ω
- Sinewaves to 6 MHz

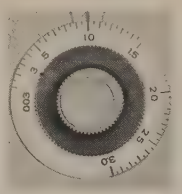



INTERSTATE ELECTRONICS CORPORATION

**$645**

# F36 AM/FM

**SERIES 30 AM/FM function generators are IEC's value leaders, presenting good, economic performance and economy in the 0.03 Hz to 3 MHz frequency range. Incorporating the sine, square, triangle, and pulse waveforms, F36 AM/FM is a versatile source for both amplitude modulation and frequency modulation, and includes selectable operating modes and a number of other significant capabilities:**



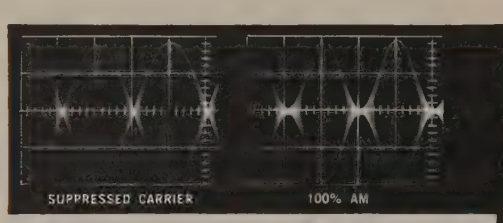
**CALIBRATED COARSE-FINE TUNE:** Operates over full 1000:1 manual tuning range. Smooth-acting planetary drive permits precise frequency setting with either coarse or fine tune verniers.

**ADJUSTABLE D-C LEVEL:** "Zero waveform" for tests requiring active source without a-c signal presence and as d-c source for d-c gain tests.

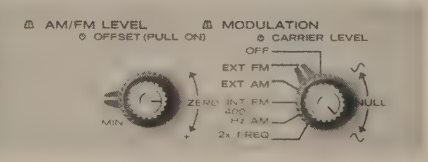
**PUSH-PULL OFFSET:** Switch on front panel permits switching to or from any offset level, positive or negative, directly to zero offset. Full ±5v range in 50Ω.

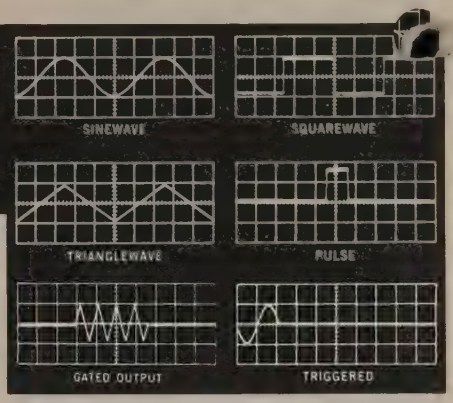
**VARIABLE WIDTH PULSE:** In addition to sine, square, and triangle output functions. Permits use in both waveform and pulse generator applications.

**PLUG-IN IC's:** On critical circuits, plus fully accessible components and adjustments for easy maintenance.




**INTERNAL 400 Hz SINEWAVE:** As either AM or FM modulating source, eliminates need for second signal generator in many applications. In external or internal AM modes, modulation level and carrier level controls set desired AM characteristics. In FM mode, modulation level control sets frequency deviation. Carrier level control also shifts phase of carrier 180° with respect to carrier sync signal. In modulation OFF, main 50Ω output bypasses all modulation circuitry.




**EXTERNAL SYNCHRONIZATION:** Of output frequency with external reference for tests requiring coherent signals, for modifying waveforms of precision reference to sine, square, triangle, or pulse. Synchronizes to fundamental, multiple, or submultiple of reference frequency.

**5-STEP ATTENUATOR AND 0-20 db VERNIER:** Full 70-db range signal level control with maximum resolution, without disturbing set characteristics of carrier modulation.

## SPECIFICATIONS

### WAVEFORMS

**VARIABLE AMPLITUDE:** Sine, square, triangle, adjustable d-c level (no a-c waveform), variable duty cycle pulse variable 5 to 95% of full duty cycle (135 nsec minimum). All waveforms symmetrical about ground or may be offset. Output impedance is 50 Ω.
**FIXED AMPLITUDE:** Carrier Sync: sinewave, 2 v p-p open circuit, in phase or 180° out of phase with main (carrier) sinewave as set with carrier level control; output impedance, 600 Ω. Rear-mounted Quadrature Sync: squarewave, 50 nsec rise time, 2 v p-p open circuit, shifted 90° in phase from sine and triangle outputs; output impedance is 50 Ω.

### FREQUENCY

**RANGE:** 0.03 Hz to 3 MHz in six decade ranges with 1000:1 continuous coarse and fine vernier adjustment within any range. Sinewaves to 6 MHz in 2X Frequency Mode.
**DIAL ACCURACY:** ±2% of full scale.
**TIME SYMMETRY:** >99% to 1 MHz.

### AMPLITUDE

**MAXIMUM OUTPUT:** 20 v p-p into open circuit.
**ATTENUATOR:** 0 to −40 db in 10-db steps; with additional 0 to 20 db continuous vernier; total range >60 db.
**SINE FLATNESS:** Better than ±0.5% 0.3 Hz to 300 kHz; better than ± 2% on X1M range.*
**SINE DISTORTION:** <0.3% on lowest four ranges; <0.5% on x100K range; <2% on X1M range.*
**SQUAREWAVE AND PULSE:** Rise-fall times <60 nsec, <5% total aberration.*
**TRIANGLE LINEARITY:** >99% between 3 Hz and 300 kHz.*

### OFFSET

Continuously variable ±10 v into open circuit, push-pull selector. Total signal plus offset limited to ±10 v independent of vernier control, attenuated proportionally with step attenuator.

### STABILITY

Frequency, amplitude, offset stability better than 0.05% for 10 minutes, 0.25% for 24 hours. *

### EXTERNAL SYNCHRONIZATION

Output frequency can be synchronized to external periodic reference signal >3 v p-p (100 v p-p max) applied to Trigger/Sync input when generator is in continuous or AM mode and is tuned within 1% of reference frequency. Input impedance is 5 kΩ.

### MODES

**CONTINUOUS:** Operates as standard Function Generator with frequency determined by frequency control settings in parallel with FM input.
**TRIGGER:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at Trigger/Sync input initiates one complete waveform cycle. Trigger Level control determines any triggering point on input waveform. Input impedance is 10 kΩ.
**GATE:** Manual or external signal >±1 v (±3 v on X1M range), 100 v max, at the Trigger/Sync input gates main generator output on for the duration of the gate signal with last cycle completed after gate is removed.

### MODULATION

**AM:** AM modulation 0 to 100% with external 0 to 5 v modulation signal at AM input. Also performs suppressed-carrier double side-band modulation. Modulation characteristics constant with modulation signal frequencies to >300 kHz (useful to 3 MHz). Max output level (carrier modulation), 20 v p-p into open circuit. Dynamic range (null depth), >40 db. External a-c or d-c level at AM input also controls amplitude of square, triangle, or pulse waveforms. Input impedance is 2.5 kΩ.
**FM:** External a-c or d-c voltage control (FM), of output frequency. 10 v change varies output frequency over three decades (60 db) on any single range, linear to within 0.25%, except on X1M range. Bandwidth is 100 kHz, input limited to 0.3 v/μsec.
**INTERNAL AM/FM:** Same as AM/FM above, with internal 400 Hz sinewave used as modulation signal.
**2X FREQUENCY (FREQUENCY DOUBLING):** Sinewave frequency twice dial setting, to 6 MHz max, at approximately ½ set amplitude (10 v p-p open circuit max).

### ISOLATION

Grounding screw may be removed to electrically isolate all BNC connectors and circuit grounds from case and powerline ground. Maximum isolation is ±500 v.

### OPERATING TEMPERATURE

0° to 50°C.

### POWER

115 vac or 230 vac ±10%, 50-400 Hz, 25 w maximum.

### DIMENSIONS

11⅛" wide x 5¼" high x 12¾" deep (28.2 x 13.3 x 32.3 CM).

### WEIGHT

11 lb. (5 kg) Net, 15 lb. (7 kg) shipping.

**NOTES:** Except where indicated, specifications apply with 25°C±5°C ambient; with 50 Ω resisitve load; 0 vdc offset; frequency controls set between 0.3 and 3 on the frequency dial; all external inputs removed and after 30-minute warm-up. Specifications subject to change without notice.
*AM Modulation off.

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Printed in U.S.A. '572

# CONTENTS


| Paragraph | | Page |
|---|---|---|
| | **Section 1. SPECIFICATIONS AND INSTALLATION** | |
| 1-1 | Introduction. | 1-1 |
| 1-2 | Description. | 1-1 |
| 1-3 | Receiving and Inspection | 1-1 |
| 1-4 | Installation. | 1-1 |
| 1-5 | Power Requirements. | 1-2 |
| 1-6 | Repackaging | 1-2 |
| 1-7 | Disassembly | 1-2 |
| 1-8 | Specifications | 1-2 |
| | **Section 2. OPERATING INSTRUCTIONS** | |
| 2-1 | Introduction. | 2-1 |
| 2-2 | Operating Features | 2-1 |
| 2-3 | Operating Notes | 2-1 |
| | a. D-C Waveform | 2-1 |
| | b. D-C Offset vs Amplitude Controls | 2-1 |
| | c. Ramp Waveform (F34, F37) | 2-1 |
| | d. Positive Ramp Waveform (F34, F37). | 2-1 |
| | e. Triggered Burst (F34, F37) | 2-1 |
| | f. Output Limit Light (F33, F34, F37) | 2-2 |
| | g. Sweep Ramp Time (F34, F37) | 2-2 |
| | h. External Sync (F33, F34, F37) | 2-2 |
| | i. Slew Rate Limitations | 2-2 |
| | **Section 3. CIRCUIT DESCRIPTION** | |
| 3-1 | Introduction. | 3-1 |
| 3-2 | Power Supply | 3-1 |

| Paragraph | | Page |
|---|---|---|
| 3-3 | Triangle Generation | 3-1 |
| | a. Frequency Control | 3-1 |
| | b. Current Sources | 3-3 |
| | c. Follow Amplifier | 3-3 |
| | d. Voltage Level Sensor | 3-3 |
| | e. Start/Stop Control (F33, F34, F37) | 3-3 |
| 3-4 | Sine Shaper | 3-3 |
| 3-5 | Variable Pulse Generator (F33, F34, F37) | 3-4 |
| 3-6 | Output Amplifier | 3-4 |
| 3-7 | Logic Circuits (F33, F34, F37) | 3-4 |
| 3-8 | Sweep Generator (F34, F37) | 3-5 |
| 3-9 | Log Sweep Converter | 3-5 |
| 3-10 | Output Limit Circuit | 3-5 |

**Section 4. CALIBRATION AND PERFORMANCE**

| | | |
|---|---|---|
| 4-1 | Introduction | 4-1 |
| 4-2 | Suggested Receiving Inspection Tests | 4-1 |

**Section 5. MAINTENANCE**

| | | |
|---|---|---|
| 5-1 | Introduction | 5-1 |

**Section 6. PARTS LIST**

| | | |
|---|---|---|
| 6-1 | Introduction | 6-1 |
| 6-2 | Parts List Tables | 6-1 |

# ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| | **Section 1. SPECIFICATIONS AND INSTALLATION** | |
| | SERIES 30 Data Sheets | 1-3 |
| | **Section 2. OPERATING INSTRUCTIONS** | |
| 2-1 | Front Panel Controls and Indicators | 2-3 |
| 2-2 | Rear Panel Fuse and Connectors | 2-4 |
| | **Section 3. CIRCUIT DESCRIPTION** | |
| 3-1 | Simplified Block Diagram | 3-2 |
| 3-2 | Logic Sequence Timing Diagram | 3-6 |
| | **Section 4. CALIBRATION AND PERFORMANCE** | |
| 4-1 | Adjustment Location Diagram | 4-15 |
| 4-2 | Test Point Location Diagram | 4-17 |
| 4-3 | A-3 Card Log Converter | 4-18 |
| 4-4 | Start/Stop Variable Baseline Adjustment (Optional) | 4-18 |
| | **Section 5. MAINTENANCE** | |
| 5-1 | Waveform Switch (S3) | 5-1 |
| 5-2 | Attenuator Switch (S5) | 5-1 |
| 5-3 | Mode Switch (S6) | 5-2 |
| 5-4 | Sweep Time Switch (S7) and Sweep Time Vernier (R287) | 5-2 |
| | **Section 6. PARTS LIST** | |
| | SERIES 30 Detailed Schematic (See rear of manual.) | |

# TABLES


| Table | | Page |
|---|---|---|
| | **Section 4. CALIBRATION AND PERFORMANCE** | |
| 4-1 | Test Equipment Required | 4-2 |
| 4-2 | Calibration and Performance Checks | 4-3 |
| | **Section 5. MAINTENANCE** | |
| 5-1 | Troubleshooting Guide | 5-3 |
| | **Section 6. PARTS LIST** | |
| 6-1 | List of Manufacturers | 6-1 |
| 6-2 | Parts List | 6-2 |

# Section 1

# SPECIFICATIONS AND INSTALLATION

## 1-1. INTRODUCTION

This manual has been carefully prepared to complement the actual hardware design features of your IEC SERIES 30 function generator by providing data on its operation, maintenance, and performance testing. The manual provides the operator with understanding of the functions, maintenance, and troubleshooting of the units, and provides specific calibration laboratory tolerances, specifications, measurements, and adjustments in the event a malfunction occurs. However, it should be noted that the function generators have been designed so that constant reference to the manual is not necessary to operate the equipment.

## 1-2. DESCRIPTION

Your IEC SERIES 30 function generator is a state-of-the-art signal source designed for great versatility, maximum ease of operation, and long operational life.

The case enclosing the equipment provides exceptional physical ruggedness and utility together with effective electrostatic shielding. The latter is important for the radio-frequency operating ranges of the instruments. Attention has been given to ground isolation applications and a grounding strap is provided at the rear of each instrument.

The serial number and other identification data are located at the rear of the instrument. The rear panel also serves as the primary heatsink for the power supply.

## 1-3. RECEIVING AND INSPECTION

Immediately upon receipt of the instrument, inspect the exterior of the shipping container for physical damage and notify the carrier if such damage is visible. After carefully removing all packing materials, inspect the instrument to ensure that it is free of mars and blemishes.

Confirm electrical performance that meets or exceeds the specifications as soon as possible. Section 4 contains a suggested receiving performance test procedure.

## 1-4. INSTALLATION

This instrument may be used on the workbench or rigidly mounted in a RETMA rack structure by means of an optional rack-mounting kit. As initially shipped, the instrument has a handle that facilitates carrying and a bottom-mounted tilt mechanism for optimum panel viewing angle. The feet and handle must be removed for proper rack mounting.

This all solid-state instrument requires no special cooling facilities when operated within the specified temperature limits. Care must be taken to ensure that a 2-inch minimum clearance is provided at the rear of the instrument for proper convection cooling of the heatsink.

## 1-5. POWER REQUIREMENTS

This instrument operates from a-c power only, either 115 or 230 vac (±10%), 50 to 400 Hz. A slide switch at the rear of the equipment readily selects the desired power line voltage. Fuses for the instrument are contained in a separate envelope. Install the proper fuse for the line voltage selected.

**CAUTION**

Operation at the wrong power line voltage switch setting may damage the instrument.

On those instruments supplied with slide switches for selecting normal- or low-line voltage operation, the following chart indicates the proper switch settings.

| OPERATING RANGES | | |
|---|---|---|
| LINE | NORM | LOW |
| 115V | 126 | 110 |
| | 104 | 90 |
| 230V | 252 | 220 |
| | 208 | 180 |

A three-conductor cord is supplied with the equipment to permit referencing the chassis and case to power system ground. This safety feature is recommended by the National Electrical Manufacturers Association (NEMA). The offset pin on the power cord connector is the ground wire. Generator circuitry (including input and output BNC's) may be isolated from the case ground by removing a grounding screw on the back panel of the instrument.

## 1-6. REPACKAGING

If it becomes necessary to pack the instrument for shipment, the following procedure is recommended:

a. Attach a tag bearing the owner's name address, and telephone number together with a brief description of the purpose of the shipment and the date its return is desired.

b. Wrap the equipment in heavy paper or plastic before placing it in an inner container.

c. Liberally use soft packing material around all sides of the instrument inside the inner container.

d. Enclose the inner container in a rugged carton or wood box with suitable packaging material to prevent movement in any direction and seal the outer container with heavy tape or metal bands.

e. Mark the shipping container with the shiping address and "DELICATE INSTRUMENT" labels.

## 1-7. DISASSEMBLY

To remove the function generator from its case, remove the two 6-32 retaining screws mounted in the bottom of the case at the rear of the unit and slide the electronics forward.

## 1-8. SPECIFICATIONS

The following data sheets provide the specifications on the F31, F33, F34, and F37 function generators. While these data sheets represent the most accurate specifications available at the time of publication, IEC reserves the right to modify the specifications at any time and to note such modifications in an errata page at the back of this manual.

# Section 2
# OPERATING INSTRUCTIONS

## 2-1. INTRODUCTION

Your IEC SERIES 30 function generator is designed to permit the operator to realize the full potential of the instrument without extensive reference to the manual. However, for personnel not familiar with this type of equipment, figures 2-1 and 2-2 are provided for quick reference.

As shown in Figures 2-1 and 2-2, there is a high degree of commonality in the controls among the various models. Refer to the individual function generator pictures on the specification data sheets (paragraph 1-8) for detailed differences in controls and nomenclature.

## 2-2. OPERATING FEATURES

The names and functions of the front and rear panel controls, terminals, and indicators are shown in Figures 2-1 and 2-2.

## 2-3. OPERATING NOTES

While operation of your IEC function generator is quick and straightforward, the following notes and comments are offered to aid the user in realizing the full potential of the instrument:

a. D-C WAVEFORM.- Removes all a-c components from the output of the main amplifier while retaining any d-c offset that may be set up. Turning off the OFFSET control, leaves only the 50-ohm output impedance coupled into the device under test (Thevenin equivalent).

b. D-C OFFSET VS AMPLITUDE CONTROLS.- The output d-c offset is independent of the continuously variable OUTPUT LEVEL control, but is controlled by the AMPLITUDE step attenuator control. Thus, signal amplitude may be varied over a 10:1 range (20 db) without affecting the d-c offset.

c. RAMP WAVEFORM (F34, F37). - No ramp waveform will appear at the output unless the MODE switch is in the BURST, CONT SWP, or TRIG SWP position. In the latter mode, the ramp may be triggered just as any other waveform (negative-going ramps in all cases).

d. POSITIVE RAMP WAVEFORM (F34, F37). - A positive-going, constant-amplitude ramp from the sweep generator is available at the rear panel SWP MON BNC connector while in the CONT SWP or TRIG SWP mode. The FREQ ANALOG BNC connector also generates a positive-going ramp in these modes; however, its amplitude and baseline offset are dependent on the settings of the FREQUENCY and SWEEP LIMIT dials. In the LOG SWEEP mode the FREQ ANALOG output is a log curve (F37).

e. TRIGGERED BURST (F34, F37). - Under normal operation, triggered burst is not available since the main generator is triggered by the free-running internal sweep generator. However, a triggered burst may be created by setting (1) the MODE control to TRIG SWP, (2)

the SWEEP LIMIT control to zero sweep width, and (3) introducing a trigger signal at the TRIG SYNC input connector (or triggering manually). The period of each cycle in the burst is controlled by the main generator frequency controls, and the duration of the burst is controlled by the SWEEP TIME controls. Interesting effects such as discrete fractions of a cycle may be created. Swept burst may also be created by adjusting the SWEEP LIMIT control. Actual frequency end points of a swept burst are best determined by careful measurement of the FREQ ANALOG voltage.

f. OUTPUT LIMIT LIGHT (F33, F34, F37). - Glows when any combination of the D-C OFFSET and the continuously variable OUTPUT LEVEL control is such that the maximum voltage swing of the output amplifier is approached. Adjusting the output AMPLITUDE step attenuator will not affect this light because the attenuator is located after the amplifier final stage. This is a "predictor" circuit; it operates independent of mode or waveform selection.

g. SWEEP RAMP TIME (F34, F37). - The SWEEP TIME controls are calibrated in ramp up time (±5 percent) and this does not include the retrace (ramp return time) of about 10 percent. Thus, the sweep repetition rate is not a simple reciprocal of the sweep time.

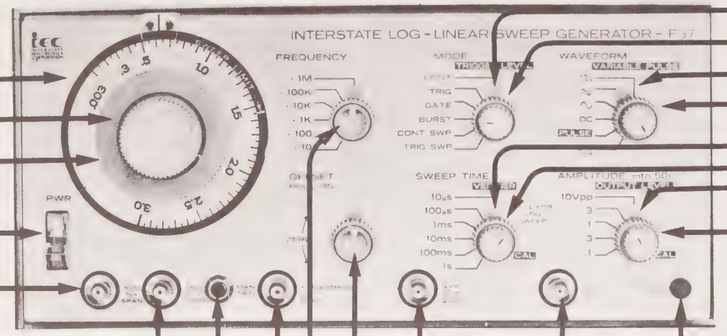
h. EXTERNAL SYNC (F33, F34, F37). - This feature (sometimes called "simple sync") permits the function generator main oscillator to be "pulled" to match the repetition rate of an external periodic signal. This pulling action is limited to about 1 percent of the operating frequency and tends to degrade above 1 MHz. The sync action is also useful in generation of harmonic and subharmonic relationships to the external signal.

NOTE

Be certain to remove the external signal when not using it because it will introduce phase jitter when not synchronized.

i. SLEW RATE LIMITATIONS. - Either the VCG input or the internal sweep generator may be adjusted occasionally to create voltage slewing rate commands in excess of the specified (0.3 v/sec) ability of the instrument to follow. Problems of this type will reflect in the behavior of the instrument in the following manner:

- Output Frequency - The change in output frequency will be less than expected for a slower slew rate.
- Freq Analog Output - The voltage swing will be less than expected and may have a d-c offset.
- CONT SWP Mode - In this mode of operation, the slew limitation may be encountered in the sweep ramp retrace period because it slews at ten times the rate of the basic ramp. A similar problem may be encountered during the last operation of a logarithmically swept ramp.




**SWEEP LIMIT Dial (F34, F37)**
Dial is directly coupled to SWEEP LIMIT potentiometer and provides a means of selecting the maximum frequency in the SWEEP mode.

**FREQ Vernier**
Planetary drive control provides a 6:1 vernier on the FREQ dial.

**FREQ Dial**
Larger knob and dial are directly coupled to the frequency control potentiometer which provides a means of adjusting the frequency (continuously) over a 1000:1 range.

**PWR Switch**
Push-rocker switch controls input power to the instrument. The switch is illuminated in the ON position.

**VCG Input Conn.**
BNC connector provides a means to apply input voltage which controls the frequency generation over a 1000:1 range.

**TRIG SYNC Input Conn. (F33, F34, F37)**
Dual-purpose BNC connector provides an input for trigger signals in the following modes: TRIG, GATE, BURST (F34 only), and TRIG SWP (F34 only).

In the CONTinuous mode the BNC provides means to synchronize the function generator to an external signal. Tune generator within 1 percent of external signal for sync on fundamental. (See Section 4.)

**MAN TRIG Pushbutton (F33, F34, F37)**
Pushbutton permits manual triggering for the following modes: TRIG, GATE, BURST (F34 only), and TRIG SWP (F34 only).

**FREQ ANALOG OUT (F34, F37)**
Output BNC provides a voltage analog of the main generator frequency including VCG, sweep, and dial variables. (Also provides inverted sweep waveform in sweep modes.)

**FREQUENCY Multiplier Switch**
Rotary switch selects one of six frequency decade ranges.

**OUTPUT LIMIT Light ( F33, F34, F37)**
Warns the user when the output amplitude is near saturation or distortion because of misadjustment of OFFSET and/or OUTPUT LEVEL potentiometer.

NOTE

Light is independent of step attenuator setting.

**OUTPUT Conn.**
Main generator output as selected by the waveform switch.

**SYNC OUT Conn.**
BNC connector provides a 2-volt peak-to-peak (open circuit) squarewave.

**OFFSET**
Dual control combining a push-pull offset switch and waveform d-c offset potentiometer.

In the push-in position the potentiometer is disabled and 0 volts offset results.

In the PULL-ON position the output offset is continuously variable from -10 to +10 volts (open circuit).

**MODE Switch (F34, F37)**
6-position rotary switch provides selection of one of six function generator modes of operation: CONTinuous, TRIGgered, GATEd, BURST, CONT SWP (turns on sweep generator), and TRIG SWP (one sweep cycle).

**TRIGGER LEVEL Potentiometer (F33, F34, F37)**
Provides a means to control the triggering sensitivity of the logic to inputs on the TRIG SYNC input BNC. This control is useful for the TRIG, GATE, BURST (adjusts number of cycles/burst), and TRIG SWP mode positions.

**WAVEFORM Switch (F31 )**
Rotary switch selects one of four waveforms: ⎍, ⩙, ∿ and DC.

**WAVEFORM Switch (F33)**
5-position rotary switch selects one of five waveforms: ⎍, ⩙, ∿, DC, and PULSE.

**WAVEFORM Switch (F34, F37)**
6-position rotary switch selects one of six waveforms: ⎍, ⩙, ∿, DC, PULSE, and ⩘

NOTE

⩘ appears only when CONT SWP, BURST, or TRIG SWP mode has been selected.

**VARIABLE PULSE Vernier (F33, F34, F37)**
Potentiometer controls the duty cycle of the rectangular pulse duration of the VARIABLE waveform.

**SWEEP TIME Switch (F34, F37)**
6-position rotary switch provides selection of six ranges of sweep duration: 10 μsec, 100 μsec 1 msec, 10 msec, 100 msec, and 1 sec.

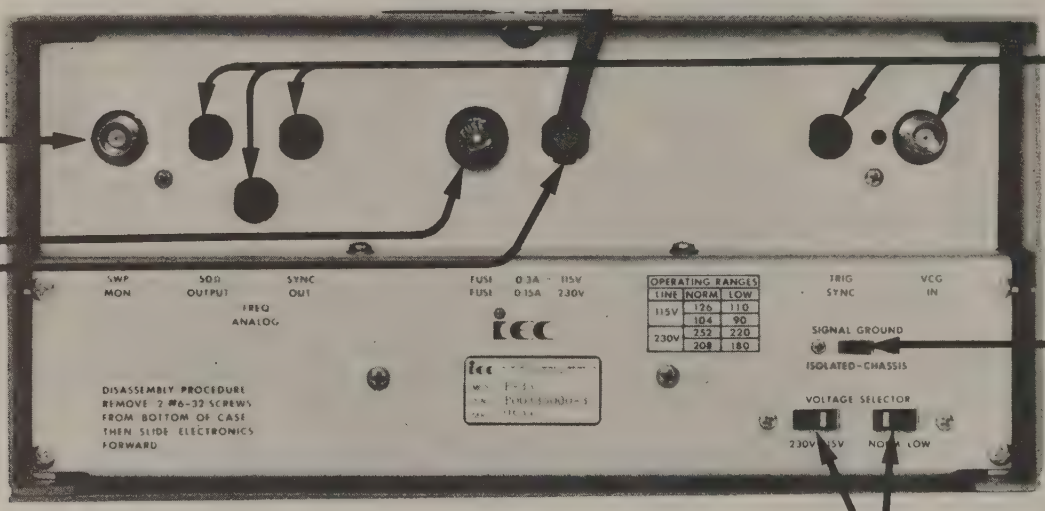
**SWEEP TIME Vernier (F34, F37)**
Potentiometer provides a continuous 100:1 control of the sweep time. Full-scale sweep time, as indicated by SWP TIME switch, is obtained at the CAL position.

**LOG SWEEP Switch (F37)**
Pull for 3 decade logarithm sweep. Sweep Limit dial operates same in log or linear sweep.

**AMPLITUDE OUTPUT (F33, F34, F37)**
5-position rotary switch, 10-db step attenuator provides 10, 3.16, 1.0, 0.316 and 0.10 volts peak-to-peak maximum signal amplitudes.

**OUTPUT LEVEL Potentiometer ( F33, F34, F37)**
20-db range potentiometer used for continuous amplitude control. Pull out on F31 only for additional 20 db attentuation.

Figure 2-1. Front Panel Controls and Indicators




**Power Cord**
Power cord may be used for nominal 115 or 230 vac applications. Includes safety ground prong which is connected to chassis.

**LINE VOLTAGE Switches**
DPDT slide switches provide easy means of a-c line voltage selection.

**FUSE**
Power fuse holder allows easy replacement: 0.3-amp SLO BLO for 115 vac, 0.15-amp SLO BLO for 230 vac.

**CKT GRD ISOLATION**
Slide switch provides a connection between chassis ground and signal ground.

**SWEEP MONITOR BNC (F34, F37)**

**Optional BNC Connector**
Five BNC ports are provided for optional connections, rear panel indicates use of each BNC. (VCG standard on rear panel only)

**Figure 2-2. Rear Panel Fuse and Connectors**

Width control R210 are summed. Q50 is an output buffer for providing a frequency analog voltage to the current control circuits and also to IC17 which drives an external frequency analog out connector (F34 only).

b. CURRENT SOURCES. - Generation of two equal and opposite currents is accomplished by IC2 and Q3 for negative current, and IC1 and Q2 for the positive current. The diode switching bridge, CR3 through CR10, allows only one current at a time to be applied to the integrating capacitors, C1 through C10. A voltage level generated in the VLS section selects the polarity of the current.

c. FOLLOW AMPLIFIER. - The follow amp is a unity gain amplifier with extremely high input impedance that prevents integrating capacitor loading which would result in a bowed triangle waveform. Low-impedance outputs provide triangle waveforms to the system. The input of the follow amp is a JFET source follower. The Vgs offset is compensated by adjusting R29.

d. VOLTAGE LEVEL SENSOR. - The voltage level sensor (VLS) provides switching signals to the diode bridge and also generates low-impedance squarewaves of controlled amplitude to the output amplifier and logic sections. The rising triangle voltage level present at the follow amplifier output is compared with a reference voltage at the input to the differential comparator, IC5. When the follow amplifier output reaches the reference voltage, IC5 changes state producing a signal which is fed back to the diode bridge (CR3 through CR10) in the current amplifier. It also produces a new reference comparison voltage at pin 4 of IC5 which generates the required hysteresis. Adjustments R51 and R54 enable the reference voltage to be set up so that a symmetrical waveform is produced.

Q7 and Q8 form a complementary emitter follower with low-output impedance. This output is the squarewave function which may be selected by the waveform switch. R63 provides an adjustment for the d-c level (amplitude symmetry) of the squarewave output.

Q51 (F33, F34, F37) provides a means of shifting the VLS reference level approximately 1 percent. When an external repetitive waveform is applied at the Trigger/Sync connector, Q51 serves to advance the VLS switching point and thus obtain synchronous operation.

e. START/STOP CONTROL (F33, F34, F37). - This circuit forms a three-element gate whose inputs are two logic levels and one analog level. When a stop command level is present and the VLS squarewave signal indicates that the triangle is negative going, the output of the follow amplifier is compared to a reference level (zero volts). When the triangle voltage reaches this reference, the Start/Stop Amplifier becomes active and causes the integrating capacitor charging current to be bypassed from the capacitors through CR58, thereby clamping the voltage of the triangle waveform to the reference. When the stop command ceases, the integration process resumes as the Start/Stop Amplifier is deactivated and CR58 is reverse biased. See Figure 4-4, page 4-18, for details of valuable baseline adjustment option.

### 3-4. SINE SHAPER

Sinewaves are produced by shaping the triangle waveform with shunt diode-resistor networks. Integrated circuits IC7 and IC8 contain

matched diode sets which, in series with R74 resistor elements, load the triangle and thereby inscribe a sinewave into the original triangle waveform. IC6 functions as an inverting operational differential buffer amplifier with emitter follower output, which reconstitutes the peak-to-peak value of the sinewave to the same amplitude as the incoming triangle. Potentiometer R81 adjusts the gain of the buffer amplifier. Q13 and Q14 act as diode shunts as well as common-base amplifiers which aid in the generation of a zero slope at the sine peaks. This is done by injecting a common mode signal via R98 and R97 into the noninverting side of the buffer amplifier.

### 3-5. VARIABLE PULSE GENERATOR (F33, F34, F37)

Variable pulses are generated by comparing the voltage summation of the triangle waveform plus an adjustable d-c level (R248, VAR PULSE control) to a reference level by use of a differential pair, Q60 and Q59. Q60 and Q59, in addition, form a "Schmitt trigger" in conjunction with R245 and R241 which provide positive feedback and hysteresis. When the triangle amplitude at Q60 base rises above the d-c level at Q59, Q60 turns on forcing Q59 off. The complementary emitter follower output, Q57 and Q58, then switches from -3 to +3-volt output. The output will remain at +3 volts until the triangle waveform ramps negatively through the reference level at which time the output goes to -3 volts.

### 3-6. OUTPUT AMPLIFIER

The output amplifier provides an inverted 20-volt, peak-to-peak output from a 6-volt, peak-to-peak level present at waveform switch S3. A 50-ohm source resistance allows 10 volts peak-to-peak into a 50-ohm load.

IC9, Q17, and Q18 form a high-gain differential amplifier to drive a complementary follower, Q19 and Q20. Feedback controls R166 and C58 adjust the gain and transient response of the amplifier, while R119 is used to adjust offset. A constant current Q33, is used to maintain slew rates and waveform quality at low-line potentials.

Offset capability is provided by inserting a variable d-c current into amplifier summing point IC9, pin 9, via R134.

### 3-7. LOGIC CIRCUITS (F33, F34, F37)

All functional modes are accomplished by comparator amplifier IC13, four TTL and gates, IC14, and mode switch S6. The comparator amplifier sums a waveform from the trigger input connector (or from the sweep waveform) with a d-c voltage obtained from trigger level control R270. Depending on the input level and setting of R270, a negative transition of IC13 pin 9 is achieved once per input waveform.

IC14 logic levels are +3 to +5 volts high and 0 to +0.5 volts low. If either gate input is low, a high output results. Both inputs must be high to obtain a low output. Two of the gates are arranged to form a flip-flop whose output, TP25, is used to command all triggered or gated functions. TP25 is normally low and rises to high to initiate a "run" command.

- Inputs to the logic section are:
  Trigger/Sync connector.
  VLS squarewave (±3 volts) indicating state of main loop.
  Sweep "running" signal, TP29.
  Sweep waveform (used as "Burst" trigger).

- Outputs from the logic section are:

  Start/Stop command line (R282, CR68 junction).

  Sweep run command line, S6 - 2B wiper.

  Last cycle completion circuit defeat, S6 - 1A pole.

### 3-8. SWEEP GENERATOR (F34,F37)

The Sweep Generator consists of operational integrator Q51, IC15; voltage-level comparator IC16, Q62; and input-voltage reversing switch Q65. Sweep time vernier control R287 applies a variable voltage level to an integrator input resistor. Sweep time range switch S7 selects an appropriate feedback capacitor for the operational integrator. As the voltage at IC15 pin 12 rises, a level is reached which will cause comparator IC16 to reverse. This action energises Q65 and causes voltage of an opposite polarity to appear across a portion of the integrator input resistor, reversing the integrator. This results in a larger charging current and faster retrace in the sweep. As this action occurs, a new reference level is set into comparator IC16 pin 4. When the integrator level has reduced sufficiently, the comparator will again reverse, establishing original conditions. Q66 and Q64 are activated by a logic signal which stalls integrator action by shorting the timing capacitors. Q63 is a buffer amplifier which supplies a "sweep running" signal to the Logic Section.

### 3-9. LOG CONVERTER

The log converter is located on the small A-3 card located under the main circuit board. The input to the log converter circuit is always connected to the linear ramp output of the sweep generator; the LOG SWP switch (S10) selects either the linear ramp or the output of the log converter. Operational amplifier A3-IC2 reduces the input linear ramp amplitude to a level compatible with the log conversion diode at pins 6 and 7 of A3-IC1. Offset and gain are adjusted by A3-R1 and A3-R4, respectively. A3-IC4 amplifies the logarithmic analog of the sweep ramp back to the magnitude of the original ramp. A3-R23 adjusts the low voltage end of the log sweep waveform.

The log conversion diode of A3-IC1 is maintained at a constant temperature via a servo circuit which monitors the voltage across reference diode pins 9 and 10 of A3-IC1. When this voltage differs from that set by A3-R10, A3-IC3 causes A3-Q1 to draw more or less current through the remaining transistors of A3-IC1, thereby heating or cooling the chip in a manner to stabilize the log-conversion diode.

### 3-10. OUTPUT LIMIT CIRCUIT

The Output Limit circuit is a d-c analog computer which turns on the OUTPUT Limit light if the amplifier is being driven close to saturation. IC18 is an operational amplifier which sums a d-c analog of the signal amplitude with a portion of the d-c offset signal. The summation is fed to a level detector (Q48, Q49) which turns on DS2 light if the level is too high.

Since the offset signal is bipolar, diodes CR48 and C49 are required to steer the currents in order to sum the absolute value of the offset.

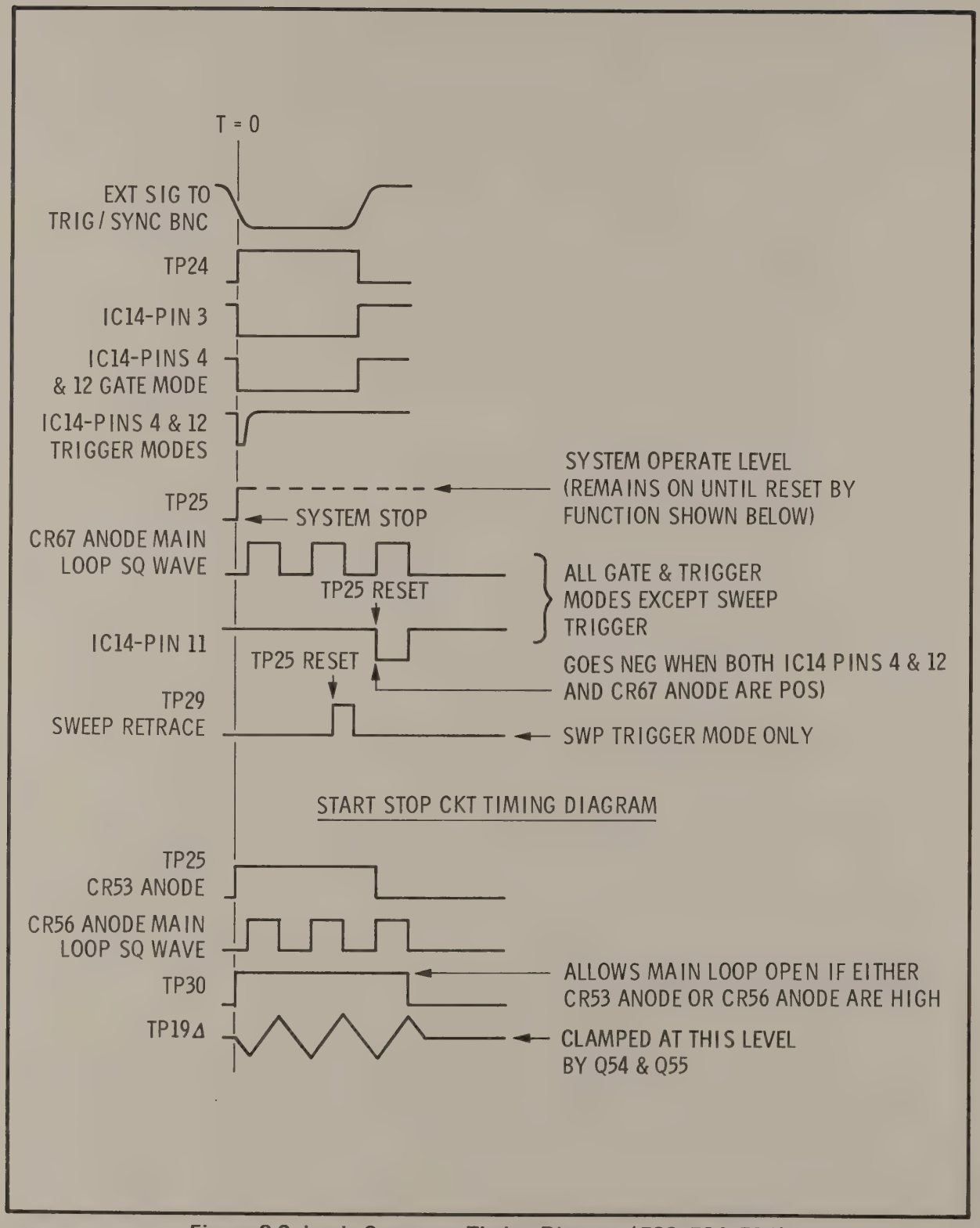

T = 0
EXT SIG TO TRIG / SYNC BNC
TP24
IC14-PIN 3
IC14-PINS 4 & 12 GATE MODE
IC14-PINS 4 & 12 TRIGGER MODES
SYSTEM OPERATE LEVEL (REMAINS ON UNTIL RESET BY FUNCTION SHOWN BELOW)
TP25
SYSTEM STOP
CR67 ANODE MAIN LOOP SQ WAVE
TP25 RESET
ALL GATE & TRIGGER MODES EXCEPT SWEEP TRIGGER
IC14-PIN 11
TP25 RESET
GOES NEG WHEN BOTH IC14 PINS 4 & 12 AND CR67 ANODE ARE POS)
TP29 SWEEP RETRACE
SWP TRIGGER MODE ONLY
START STOP CKT TIMING DIAGRAM
TP25 CR53 ANODE
CR56 ANODE MAIN LOOP SQ WAVE
TP30
ALLOWS MAIN LOOP OPEN IF EITHER CR53 ANODE OR CR56 ANODE ARE HIGH
TP19Δ
CLAMPED AT THIS LEVEL BY Q54 & Q55

**Figure 3-2. Logic Sequence Timing Diagram (F33, F34, F37)**

# CALIBRATION PROCEDURE

## Corporate Metrology Center

Issued to: **Department 206 E-Team x69093**

MFR/MODEL IEC Series 30
EQUIP DESCR Function Generator

WRITTEN BY Mark Pommerenck — DATE 28-Nov-1994
REVISED BY John A. Hastings — DATE 22-Oct-1997
Printed on 22-Oct-97 — *dd-mmm-yyyy*

VERIFIED BY _____ — DATE _____

APPROVED BY John A. Hastings — DATE 22-Oct-1997

PC Disk File: C:\winword\proc\g-NIECF30.DOC
Procedure ID:AP-IECF30.DOC

| EQUIPMENT REQUIRED | | |
|---|---|---|
| **MFR / MODEL NUMBER** | **DESCRIPTION** | **LOCATION** |
| **STANDARDS:** | | |
| Omega 485B | Hygrothermograph | Lab |
| HP 5334B | Counter | RF Area |
| HP 3456A | Digital Voltmeter | RF Area |
| HP 334A | Distortion Analyzer | RF Area |
| HP 3325A | Synthesizer | RF Area |
| Tek 2465/67 | Oscilloscope | General |
| | | |
| **ACCESSORIES:** | | |
| | | |

Specifications: Tested to Manufacturer's specifications.

Prerequisite Actions: None

Performance Test:

Follow the manufacturer's calibration and performance checks on pages 4-3 to 4-13. For the performance check, do steps marked * only. For F35/F36 series, continue with checks in the F35/F36 manual supplement that follows page 4-18 of this procedure. Do checks page 4-1 to 4-3.

# Section 4

# CALIBRATION AND PERFORMANCE

## 4-1. INTRODUCTION

This section contains the necessary equipment list and the detailed procedures for checking your Series 30 function generator for proper operation and/or for calibrating all elements of the instrument. Table 4-1 presents a recommended list of test equipment and table 4-2 provides the recommended sequence and methods. Figure 4-1 is an Adjustment Location Diagram and figure 4-2 is a Test Point Location Diagram.

## 4-2. SUGGESTED RECEIVING INSPECTION TESTS.

Certain steps in the Calibration Procedure (table 4-2) have been designated with an asterisk (*) as appropriate for Receiving Inspection Performance tests. Only those portions of the Procedure relating to measurements are to be used; adjustments are for calibration. These checks are recommended for customers who have not developed their own formal acceptance test procedures for this class of equipment.

## TABLE 4-1. TEST EQUIPMENT REQUIRED

| Test Equipment | Suggested Model | General Requirements For Calibration |
|---|---|---|
| Digital Voltmeter | FLUKE 8842 | DC: 1-mv resolution up to 15.0 vdc. |
| | HP 3490A | AC: Average reading 1-mv resolution up to 10 vac. |
| Counter | HP 5326A | FREQ: 5-digit resolution up to 5 MHz.<br>PERIOD: 200 sec with 0.1-sec resolution.<br>TIME INTERVAL: |
| POWER METER | HP 436A | 50-MHz bandwidth and 0.1-db resolution. |
| Oscilloscope | Tektronix 7000 SERIES | 50 MHz bandwidth.<br>0.1 v/cm vertical sensitivity. |
| Voltage Source | LAMBDA LP-520-FM | 10.0v maximum.<br>Settable to 1.0 mv. |
| Function Generator or Oscillator | HP 3310A | 10v p-p sinewave into 50 ohms. |
| Distortion Analyzer | HP 334A | FREQ RANGE:<br>5 Hz to 600 kHz.<br>Distortion introduced by instrument:<br><0.03 percent from 5 Hz to 200 kHz.<br><0.06 percent from 200 to 600 kHz. |

NOTE:

FOR PERFORMANCE CHECK DO STEPS MARKED * ONLY



For F35/36 Series do following procedure plus see page 4-1 in F35/36 manual Supplement following pg 4-18 of This procedure.

## TABLE 4-2. CALIBRATION AND PERFORMANCE CHECKS

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 1.0 | POWER SUPPLY | PWR - ON | DVM-DC | 1. Adjust R145 for +15.00 ±0.02v @ TP6.<br>2. Measure:<br>-15.0 ±0.1v @ TP3.<br>+5.0 ±0.25v @ TP5.<br>-5.0 ±0.25v @ TP4. |
| 2.0 | MAIN LOOP ADJUSTMENT | | | |
| 2.1 | Follow Amplitude Zero Adjust | FREQ Mult @ 1K<br>Dial @ 2.5<br>WAVEFORM @ Sine<br>MODE @ Cont | DVM-DC | 1. Short TP11 to ground.<br>2. Adjust R29 for 0 ±50 mv dc @ rear side of TP19.<br>3. Remove C9 short. |
| 2.2 | Triangle Amplitude Symmetry Adjust | | | Adjust R54 for 0 ±2 mv dc @ rear side of TP19. |
| 2.3 | Triangle Amplitude Adjust | | DVM-AC | Adjust R51 for 1.66v ±3 mv ac @ rear side of TP19. |
| 2.4 | Frequency Calibration Adjust | FREQ Dial @ 3.0 | Counter-Frequency | Adjust R4 for 3.0 kHz ±10 Hz @ Sync Out. |
| 2.5 | 1000:1 Frequency Adjust | FREQ Mult @ 10K | | 1. Measure 30 kHz ±600 Hz @ Sync Out. |
| | | FREQ Mult @ 10K<br>Dial @ CW | Counter-Period | 2. Adjust R1 (Coarse) for 67 ±33 ms @ Sync Out.<br>3. Adjust R206 (Fine) for 67 ±7 ms @ Sync Out. |
| | Low-Frequency Symmetry Adjust | | Counter Time Interval | 4. Adjust R18 for equal 1/2 period measurements to within ±2 ms @ Sync Out. |
| | | | Counter Period | 5. Readjust R206 for 67 ±7 ms @ Sync Out. |
| 3.0 | HIGH RANGES ADJUSTMENTS | | | |
| 3.1 | Triangle Flatness 1 MHz | FREQ Mult @ 1M<br>MODE @ Cont | Counter-Frequency | 1. Connect Sync Out to counter via 50 ohms terminated coax. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 3.1 (Cont) | | | ~~POWER METER~~ HP 436A X10 ATTENUATOR USC 7463, 24467 SOR2. | 2. Adjust C9 to mid-rang<br>3. Rotate the FREQ dial between .3 and 3.0 o dial. Adjust C25 for flat triangle response ±0.2 db. |
| 3.2 | Frequency Calibration 1M Range | FREQ Dial @ 3.0 Mult @ 1M | | Adjust C9 for 3.0 ±0.02 MHz. |
| 3.3 | Frequency Calibration 100K Range | FREQ Mult @ 100K | Counter-Frequency | Adjust C8 for 300 ± 2 kHz. |
| * 3.4 | Dial Linearity and Frequency Calibration | MODE @ Cont | Counter-Frequency or Period | Check frequency vs dial indication on each range per the following schedule. It is recommended that a FREQ dial setting be made and the MULT switch be switched from x1M through x10 prior to resetting the dial. Period measuremen for low frequency. |

**Frequency vs Dial Accuracy**

| Range / Dial Setting | X1M (MHz) | X100K (KHz) | X10K (KHz) | X1K (KHz) | X100 (Hz) | X10 Frequency (Hz) | X10 Period (ms) |
|---|---|---|---|---|---|---|---|
| 3.0 | 2.94 - 3.06 | 294 - 306 | 29.4 - 30.6 | 2.94 - 3.06 | 294 - 306 | 29.4 - 30.6 | 34 - 32.6 |
| 2.0 | 1.94 - 2.06 | 194 - 206 | 19.4 - 20.6 | 1.94 - 2.06 | 194 - 206 | 19.4 - 20.6 | 51.5 - 48.5 |
| 1.0 | 0.94 - 1.06 | 94 - 106 | 9.4 - 10.6 | .94 - 1.06 | 94 - 106 | 9.4 - 10.6 | 106 - 94.3 |
| 0.3 | .24 - .36 | 24 - 36 | 2.4 - 3.6 | .94 - 3.6 | 24 - 36 | 2.4 - 3.6 | 416 - 277 |
| Stop | .001 - .003 | .1 - .3 | .01 - .03 | .001 - .003 (1.0 - .33) Sec. | .1 - .3 (10 - 3.3) Sec. | | (100 - 33.3) Sec. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 4.0 | WAVEFORMS | | | |
| 4.1 * | Output Amplifier Zero Adjust | FREQ Mult @ 1K<br>Dial @ 2.5<br>WAVEFORM @ DC<br>LEVEL @ CW (Max) | DVM-DC<br>SCOPE-DC | 1. DVM to OUTPUT BNC via unterminated coax with scope as monitor.<br>2. Adjust R119 for 0 ±5mv dc on the DVM. |
| 4.2 * | Gain Adjust | WAVEFORM @ Triangle | DVM-AC | Adjust R166 for reading of 5.556 ±.010v (20.0 ±0.036v p-p). |
| 4.3 * * | Output Amplifier Squarewave Response | FREQ Mult @ 1M<br>Dial @ 3.0<br>WAVEFORM @ Sq | | 1. Adjust the level for 10v p-p on the scope.<br>2. Adjust C58 for ideal square waveform. Overshoot or aberration must be less than 5% p-p.<br>3. Measure rise and fall between 10% and 90% of amplitude (tr and $t_f$ <60 ns). |
| 4.4 * | Square Amplitude Symmetry | WAVEFORM @ Sq<br>FREQ Mult @ 1K<br>LEVEL @ mid range | DVM-DC | 1. DVM to OUT BNC via unterminated coax.<br>2. Adjust R63 for 0 ±5 mv dc. |
| 4.5 * | Square Amplitude | LEVEL @ CW (max) | DVM-AC | Measure 11.11 ±0.24 vac (if using rms respond meter)<br>or 10.00 ±0.22 VRMS |
| 4.6 | Sine Zero | WAVEFORM @ Sine | DVM-DC | Adjust R96 for 0.0 ±5 mv dc. |
| 4.7 | Sine Distortion | FREQ Mult @ 1K<br>Dial @ 1.0 | Distortion Analyzer Scope | 1. Connect the distortion analyzer to the output BNC via 50-ohm terminated coax with scope as monitor.<br>2. Adjust R77 and R89 alternately for minimum distortion. |

Table 4-2. Calibration and Performance Checks (Continued)

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| * | | | | 3. Adjust R99 and R102 alternately for minimum distortion.<br>4. Repeat Procedures 2 and 3 above, as necessary, to retain total harmonic distortion ~0.3%. |
| 4.8 | Sine Zero Slope | FREQ Mult @ 10K<br>Dial @ 3.0 | Scope-AC<br>Distortion Analyzer | Observe sine peaks @ 1 v/CM. Adjust R98 for the most rounded appearance (zero slope) which provides distortion less than 0.3%. |
| * 4.9 | Sine Amplitude Adjust | FREQ Mult @ 1K<br>Dial @ 3.0 | DVM-AC | 1. Remove distortion analyzer and connect DVM to output BNC.<br>2. Adjust R81 for reading of 7.07 ±.012 vac (20.0 ±.036v p-p). |
| * 4.10 | Sine Zero | | DVM-DC | Readjust R96 for 0.0 ±5mv dc if required. |
| 4.11 * | Sine Flatness | FREQ Mult @ 1M | ~~POWER METER~~<br>Tek 2465 Scope 2467<br>~~HP 436A~~<br>use cursors<br>~~X10 ATTENUATOR~~ | 1. Remove the DVM and connect the RF voltmeter to the output BNC monitor with scope.<br>2. Rotate FREQ dial between .3 and 3.0. Adjust C43 for ±0.2 db over the range. 2.3% |
| 5.0 | OFFSET | | | |
| * 5.1 | Zero | FREQ Mult @ 1K<br>WAVEFORM @ DC<br>OFFSET @ IN<br>AMPLITUDE @ 10v p-p<br>LEVEL @ CW stop | DVM-DC | Connect DVM (unterminated) to output BNC coax. Output shall read 0.0 ±.01 vdc. |
| * 5.2 | Variable | OFFSET pulled On | | 1. Rotate the OFFSET pot to the CW stop. DVM shall read 10.0 ±.5v. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 5.2 (Cont) | | | | 2. Rotate the OFFSET pot to the CCW stop. DVM shall read -10 ±.5 vdc. |
| * 6.0 | OUTPUT ATTENUATOR (F31) | FREQ Mult @ 1K<br>Dial @ 3<br>WAVEFORM @ Sine<br>LEVEL @ CW stop and PULL | DVM-AC | Measure 0.707 ±.015 vac @ output BNC unterminated. |
| 7.0 | OUTPUT ATTENUATOR (F32-F37) | | | |
| * 7.1 | -10 db | FREQ Mult @ 1K<br>Dial @ 3<br>WAVEFORM @ Sine<br>AMPLITUDE @ 3v p-p<br>LEVEL @ CW stop | DVM-AC | Measure 2.236 ±.045 vac @ output BNC unterminated. |
| * 7.2 | -20 db | AMPLITUDE @ 1v p-p | | Measure 0.707 ±.014 vac. |
| * 7.3 | -30 db | AMPLITUDE @ .3v p-p | | Measure 0.224 ±.009 vac. |
| * 7.4 | -40 db | AMPLITUDE @ .1v p-p | | Measure 0.071 ±.003 vac. |
| 8.0 | VARIABLE PULSE (F32-F37) | | | |
| * 8.1 | Range | FREQ Mult @ 1K<br>Dial @ 3.0<br>WAVEFORM to Variable Pulse<br>VARIABLE PULSE Vernier @ Midrange<br>LEVEL @ CW stop | Scope-DC | 1. Measure 10.0 ±1.0v p-p at OUT BNC with 50-ohm termination.<br>2. Slowly rotate the V. P. vernier from stop to stop. Observe that a full range of pulse widths are produced from -10 vdc @ the CW stop to +10 vdc @ the CCW stop. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| * 8.2 | Minimum Pulse | FREQ Mult @ 1M<br>Dial @ .5 | | 1. Slowly rotate the vernier for minimum duration pulses.<br>2. Pulse duration measured shall be less than 100 ±35 ns @ 50% of amplitude level. |
| * 9.0 | OUTPUT LIMIT CIRCUITRY (F32-34, F37) | | | |
| * | | FREQ Mult to 1K<br>Dial to 1<br>WAVEFORM to DC<br>OFFSET to ON Position<br>LEVEL to CW Stop | DVM-DC | 1. Connect DVM to output BNC via unterminated coax.<br>2. Adjust OFFSET for +2.5v. Limit lamp should glow. Adjust OFFSET to -2.5v. Lamp should glow.<br>3. Turn off OFFSET. Lamp should go out. |
| 10.0 | VCG(F32-34,F37) | | | |
| * | | FREQ Mult @ 1K<br>Dial @ CW stop<br>WAVEFORM @ Sine | Counter-Frequency<br>Voltage Source | 1. Apply 10.0 ±.01v to VCG BNC.<br>2. Connect SYNC OUT BNC to counter via 50-ohm terminated coax.<br>3. Frequency read shall be 3 kHz (+.18 - .33kHz). |
| 11.0 | START/STOP (F33,34,36,37) | | | |
| | | FREQ Mult @ 1K<br>MODE @ TRIG<br>AMPLITUDE @ 10 v p-p | DVM-DC | Adjust R228 for 0 ±60 mv dc. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| *12.0 | TRIG MODE OPERATION (F33, 34, 36, 37) | FREQ Mult @ 1K<br>Dial @ 3.0<br>MODE @ Trig<br>WAVEFORM @ Sine | Function Generator<br><br>Scope | 1. Apply 3v p-p square-wave @ 1 kHz to the TRIGGER/SYNC BNC.<br>2. Connect Scope to Output BNC.<br>3. Adjust the TRIGGER LEVEL pot until a single sine cycle is produced at the output BNC. |
| *13.0 | GATE MODE OPERATION (F33, 34, 36, 37) | FREQ Mult @ 1K<br>Dial @ 3.0<br>MODE @ Gate<br>WAVEFORM @ Sine | Function Generator<br><br><br>Scope | 1. Apply 3v p-p sinewave @ 0.3 kHz to the TRIG./SYNC BNC.<br>2. Connect scope to Output BNC.<br>3. Rotate the TRIGGER LEVEL pot from stop to stop. Observe that any number of complete cycles may be produced from 1 to 10 before repetition. |
| *14.0<br>14.1<br><br>14.2 | FREQUENCY ANALOG (F34, 37)<br>Zero<br><br>Full-Scale | FREQ Mult @ 1K<br>Dial @ CW Stop | DVM-DC | 1. Connect DVM to FREQ ANALOG BNC.<br>2. Adjust R329: for 0 ±10mv dc.<br>3. Rotate the FREQ dial to 3.0. DVM shall read 5.0 (+.3 - .55) vdc. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 15.0 | SWEEP (F34,37) | | | |
| 15.1 | AMPLITUDE | SWP TIME @ 10 ms<br>SWP VERN @ Cal<br>MODE @ CONT SWP | DVM-AC<br>DVM-DC | 1. Connect DVM to 1C15 pin 12. Measure .833 ± .016 vac (1.55 ±0.30 vdc) |
| 15.2 | DIAL CALIB A | FREQ Mult @ 10K<br>Dial @ 3.0<br>MODE @ CONT | Counter-Freq. | 1. Connect counter to Sync Out BNC.<br>2. Measure & record freq. F.<br>3. Set FREQ dial @ 1.0 Measure and record freq: $F_2$ |
| 15.3 | ZERO SWEEP ADJ. | FREQ DIAL @ 0.3<br>MODE @ CONT Swp<br>SWP LIM @ ccw Stop<br>SWP TIME @ 1 sec<br>SWP VERN @ Cal | Scope | 1. Connect scope to OUT BNC.<br>2. Adj. R203 for zero sweep (FM) on scope display |
| 15.4 | DIAL CALIB: high | SWP LIM @ 3.0 | Counter-Freq | 1. Connect counter to Sync Out BNC<br>2. Adj. SWP VERN to best observe max. frequency on counter.<br>3. Adj. R190 to obtain the same max. freq value recorded as F, above (15.1.2) within ±1%. |
| 15.5 | DIAL CALIB: Low | SWP LIM @ 1.0 | | 1. Adj. SWP VERN to best observe maximum frequency on counter.<br>2. Measure and record max freq: $F_3$<br>3. If $F_3$ is more than 5% higher than $F_2$ (recorded in stop 15.1.3 above): loosen hex nut on SWP LIM pot R210 and rotate pot CW. Remeasure $F_3$. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 15.5 | DIAL CALIB: Low (Cont'd) | | | 4. If $F_3$ is more than 5% lower than $F_2$: Loosen hex nut on pot R210 and rotate pot CCW. Remeasure $F_3$.<br>5. Repeat steps 15.2, 15.3 and 15.4 until $F_3 = F_2 \pm 5\%$ |
| 15.6 | SWEEP TIME CAL. | MODE @ Cont Swp<br>WAVEFORM @ Swp<br>SWP TIME @ Ims<br>SWP VERNIER @ Cal. | Counter-Time Interval | 1. Connect time interval counter to TP29 via 10 Megohms < 15 pf probe.<br>2. Measure time interval between positive going and negative going transitions of TP29. Adj. R288 for 1000 ±5 us.<br>3. Set SWP Time @ 10 us. Time interval (ramp up) of 10 ±0.2 us.<br>4. Check time intervals of 100 us, 10 ms, 100 ms and 1 s SWPTIME ranges for proper reading ±3%. |
| 15.7 | 100:1 Adj. | SWP TIME @1ms<br>SWP VERN @ CCW stop<br><br>SWP TIME @ 1s<br>SWP VERN @ CCW stop | | 1. Adj. R301 for time interval of 115 ±10 ms.<br>2. Time interval shall be between 105s and 130s. |
| 15.8 | SWP Base Line | SWP TIME @ 10 us<br>SWP VERN @ Cal | SCOPE | 1. Connect Scope to TP27 via x10 probe.<br>SWP retrace not to overshoot DC Zero by more than 20 mv. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 16.0 | LOG CONVERTER (F37) | | | |
| 16.1 | Temperature Controller (Ambient = 72 ±5°F) | MODE @ TRIG SWP<br>MULT @ 1K<br>WAVEFORM @ Sine<br>FREQ DIAL @ 0.3<br>SWP LIM @ 3<br>Log/Lin Switch @ Lin<br>SWEEP TIME @ 10 msec | DVM-DC | 1. Connect DVM to A3-TP3.<br>2. Adjust R10 for - 6v ±0.01v.<br>3. Allow several minutes for circuit to stabilize. |
| 16.2 | Baseline Adj. | | | 1. Ground A3-TP1 & 2.<br>2. Connect DVM to A3-TP4.<br>3. Adjust A3-R23 for -3.0 mv ±0.1 mv.<br>4. Remove A3-TP2 ground |
| 16.3 | Input Offset | | | 1. Adjust A3-R1 for 0v ±0.1 mv.<br>2. Remove A3-TP1 ground. |
| 16.4 | Swp Amplitude | MODE @ Cont. Swp. | Scope (DC) | 1. Connect Scope to FREQ ANALOG BNC.<br>2. Adjust Scope for full screen display of ramp.<br>3. Log/Lin Switch to LOG.<br>4. Adjust A3-R4 to make Log ramp same amplitude as Lin ramp. |
| 16.5 | Low Freq Test | Log/Lin Switch @ Log | | 1. Return to Step 2.5 and confirm that first half cycle time interval at beginning of sweep ≥ 30 msec. |

**Table 4-2. Calibration and Performance Checks (Continued)**

| Step | Calibration | Control Setting | Test Equipment (Mode) | Procedure |
|---|---|---|---|---|
| 17.0 | SWEEP MODES | | | |
| *17.1 | TRIG SWP Mode | MODE @ Trig Swp<br><br>SWP TIME @ 10 ms<br>SWP VERN @ Cal<br>FREQ Mult @ 1K<br>FREQ Dial @ 1.0<br><br>SWP LIMIT Dial @ 3.0<br>WAVEFORM @ Triangle | Function Generator<br><br>Scope | 1. Connect 3v p-p sine wave @ 50 Hz to TRIG/SYNC input.<br><br>2. Observe waveform as shown on scope at OUTPUT BNC. (Approximately 20 cycles of Triangular waveform with decreasing period.) |
| *17.2 | CONT SWP Mode | MODE @ Cont Swp | | 1. Remove the sinewave from the TRIG/SYNC BNC.<br><br>2. Observe on the scope the repeating swept waveform as shown at the output BNC. |
| *17.3 | BURST Mode | MODE @ Burst | | Rotate the TRIGGER LEVEL pot from stop to stop. Observe that any number of complete cycles may be produced from one to 10 before repetition. |

NOTES

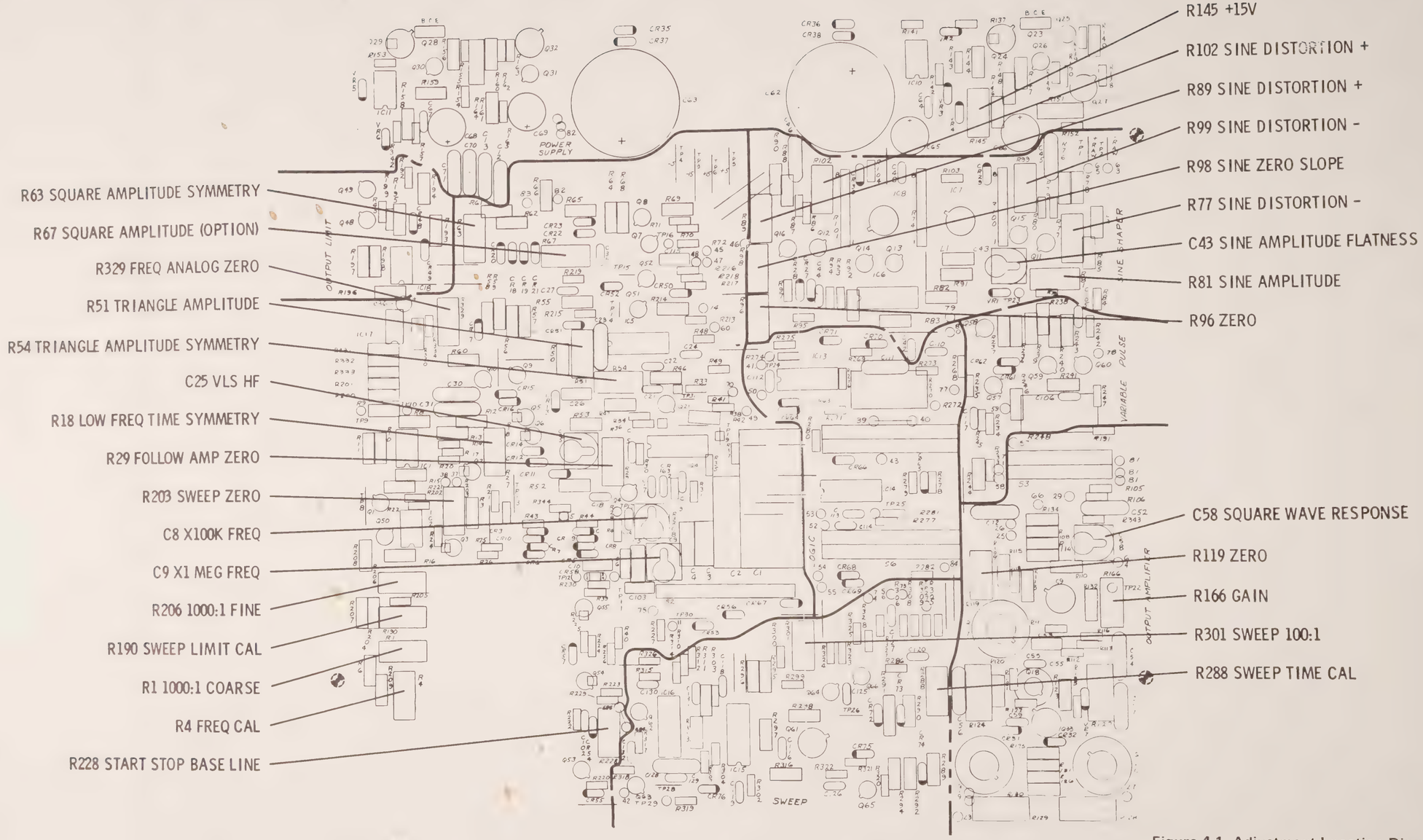



Figure 4-1. Adjustment Location Diagram

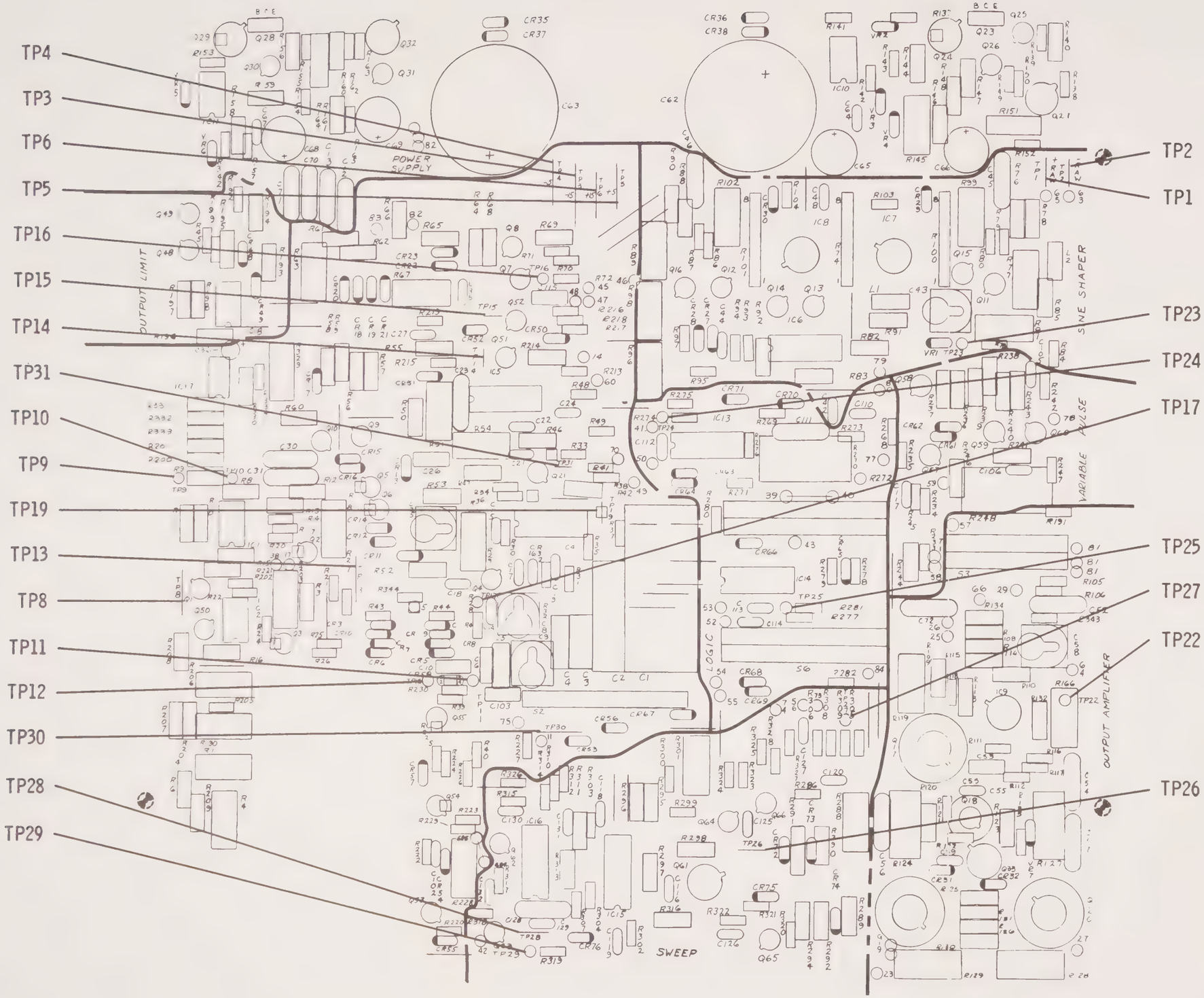



Figure 4-2. Test Point Location Diagram

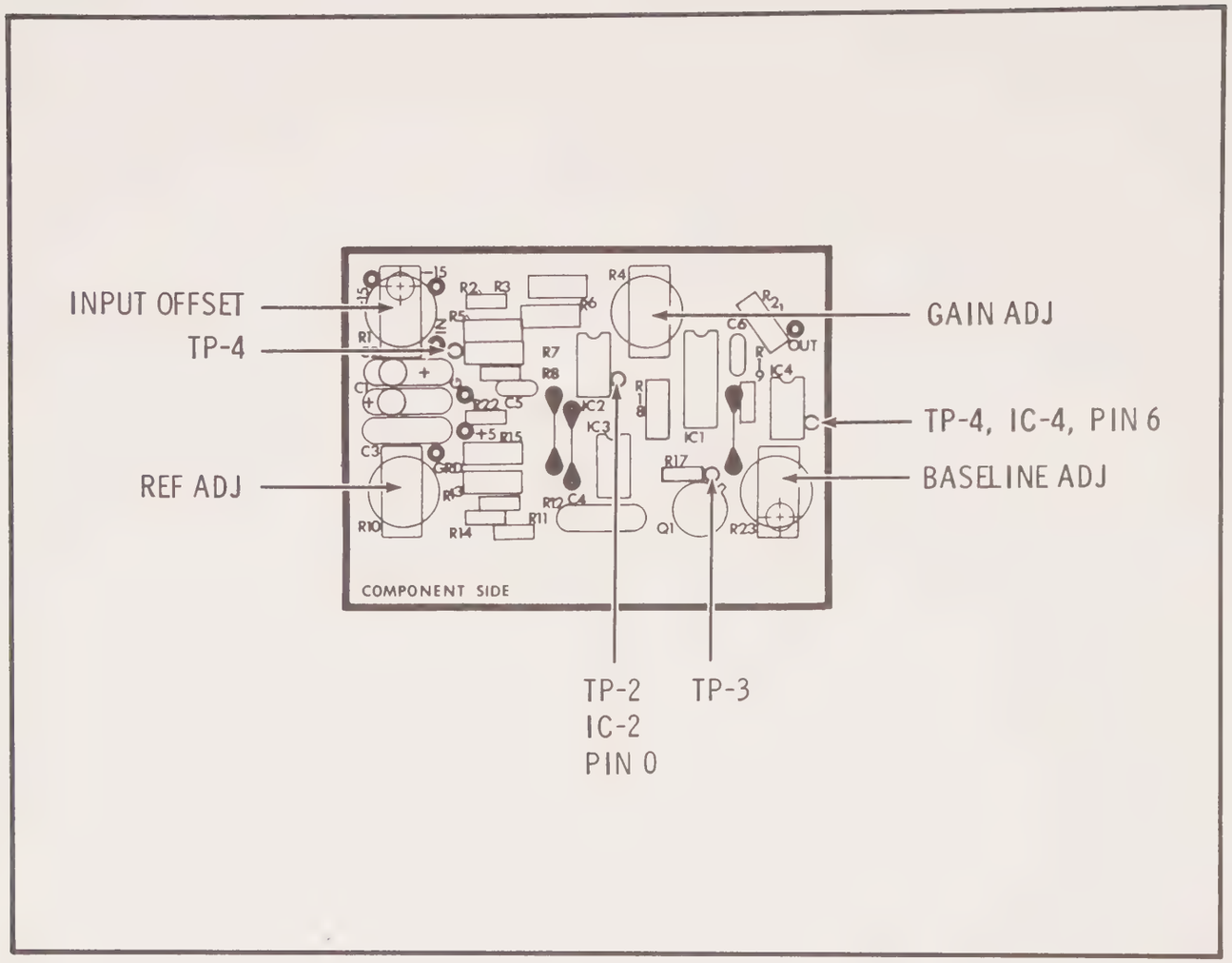



Figure 4-3. A-3 Card Log Converter

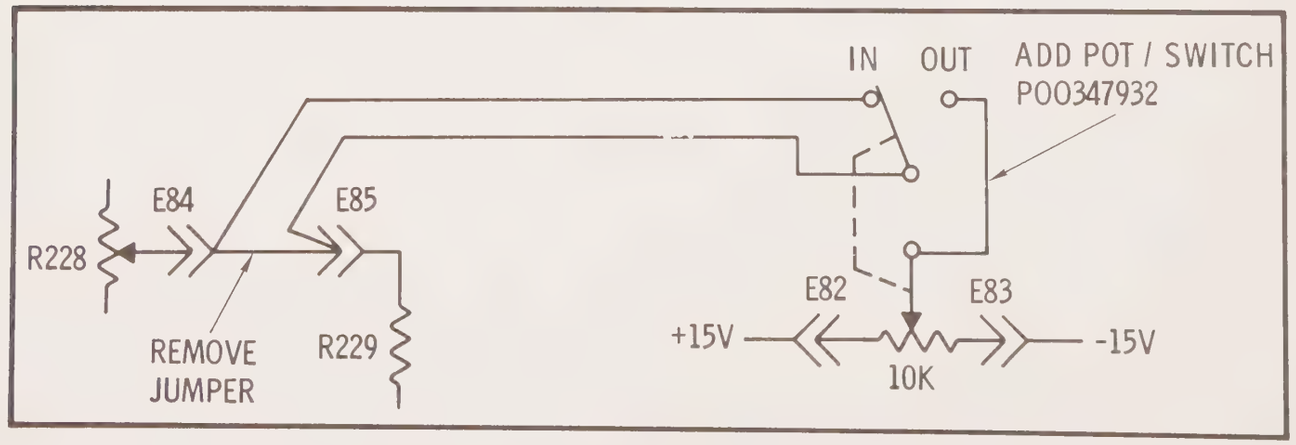



**Figure 4-4. Start/Stop Optional Variable Baseline Adjustment**

# F35/F36 AM/FM

## Supplement to

# SERIES 30 Instruction MANUAL

# CONTENTS


| Paragraph | | Page |
|---|---|---|
| | **Section 1. INTRODUCTION/SPECIFICATIONS** | |
| 1-1 | Introduction | 1-1 |
| 1-2 | Specifications | 1-1 |
| | **Section 2. OPERATING INSTRUCTIONS** | |
| 2-1 | Operating Features | 2-1 |
| 2-2 | Operating Notes | 2-1 |
| | a. Ext FM Mode | 2-1 |
| | b. Ext AM Mode | 2-1 |
| | c. AM | 2-1 |
| | d. Int 300 Hz FM Mode | 2-1 |
| | e. Int 300 Hz AM Mode | 2-1 |
| | f. 2X Freq Mode | 2-1 |
| 2-3 | Special Applications of Ext AM Mode | 2-2 |
| | **Section 3. CIRCUIT DESCRIPTION** | |
| 3-1 | Introduction | 3-1 |
| 3-2 | Modulator | 3-1 |
| 3-4 | Amplifier | 3-1 |
| 3-4 | 400 Hz Oscillator | 3-1 |
| | **Section 4. CALIBRATION AND PERFORMANCE** | |
| 4-1 | Introduction | 4-1 |
| 4-2 | Calibration/Performance Tests | 4-1 |
| | **Section 5. PARTS LIST** | |
| 5-1 | Introduction | 5-1 |
| 5-2 | Parts List | 5-1 |
| | **Section 6. DETAILED SCHEMATIC** | |

# ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 2-1 | Front Panel Controls . . . . . | 2-3 |
| 3-1 | Simplified Block Diagram . . . . . | 3-2 |
| 4-1 | Adjustment Location Diagram . . . . . | 4-4 |
| 6-1 | Detailed Schematic . . . . . | 6-1 |

# TABLES


| Table | | Page |
|---|---|---|
| 4-1 | Calibration and Performance Check Procedure (A2 card unless otherwise specified) . . . . . | 4-1 |
| 5-1 | Parts List . . . . . | 5-1 |

# Section 1

# INTRODUCTION/SPECIFICATIONS

## 1-1. INTRODUCTION

The F35/F36 AM/FM Function Generator is a straightforward extension of two models of the SERIES 30 Function Generator family. The primary modification is the addition of a new printed circuit card (A2) to the basic configuration of the F32 and F33. This creates the F35 and F36, respectively.

Information contained in this supplement refers only to the operational features and hardware contained on the supplemental printed circuit card designated A2 which is located beneath the large printed circuit card, A1.

The additional modes provided in Models F35 and F36 in no way affect basic operation of the instrument when the MODULATION switch is in the OFF position. Refer to the basic SERIES 30 Instruction Manual for all instructions and procedures other than those concerning the MODULATION features.

## 1-2. SPECIFICATIONS

The following data sheets provide the specifications on the AM/FM F35 and F36 function generators.

# Section 2

# OPERATING INSTRUCTIONS

## 2-1. OPERATING FEATURES

Figure 2-1 shows the location and describes the use of all AM/FM controls. This section is concerned only with the use of modulation functions as provided by the MODULATION switch. With this switch in the OFF position, the instrument operates as a standard F32 or F33 generator as described in Section 2 of the basic SERIES 30 Instruction Manual.

## 2-2. OPERATING NOTES

a. EXT FM MODE. - Inserts the AM/FM LEVEL control between an external voltage applied to the f-m connector and the voltage controlled oscillator circuitry. This mode is useful when the external f-m voltage level cannot be adjusted.

b. EXT AM MODE. - Inserts the modulation circuitry between the function generator waveform switch and the output amplifier. This mode provides both a-m and suppressed carrier operation as described in the following paragraphs.

c. AM. - Operation is achieved by rotating CARRIER LEVEL to establish an unmodulated carrier level. (The direction of rotation controls the carrier phase, either $0^{\circ}$ or $180^{\circ}$.) The depth, or percentage, of modulation is controlled by adjusting the AM/FM LEVEL control. It is possible to overdrive the output amplifier in this mode, and care must be taken not to clip the waveform (which occurs when total swing exceeds ±5 volts peak into 50 ohms). Upon achieving the desired depth or percentage of modulation, peak-to-peak amplitude may be reduced by use of the main OUTPUT LEVEL and OUTPUT ATTENUATOR controls.

d. INT 400 Hz FM MODE. - Connects an internal 400-Hz free-running sinewave oscillator to the voltage controlled oscillator circuitry through the AM/FM LEVEL control. The carrier frequency will be frequency modulated about the point set on the main Frequency dial.

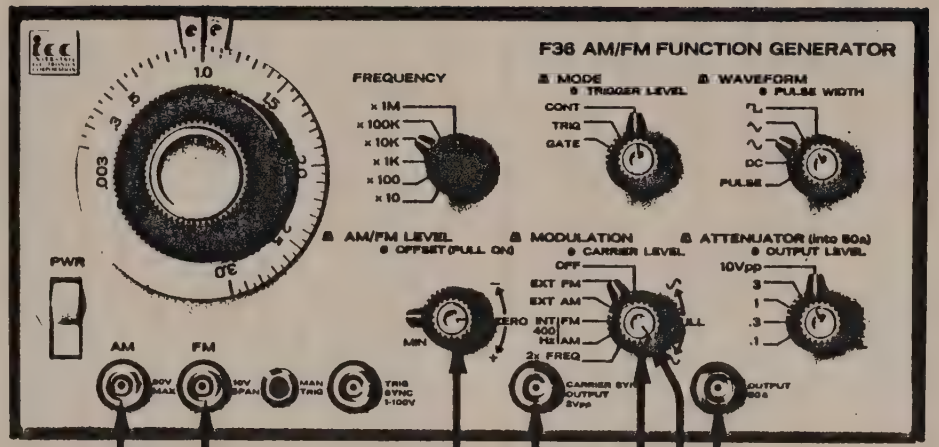
e. INT 400 Hz AM MODE. - Provides an internal sinewave modulating signal for a-m or suppressed carrier operation. No external a-m signal input is required.

f. 2X FREQ MODE. - Uses the modulator to multiply the carrier times itself. This is only meaningful (mathematically) to sinewave carriers for which the output is a sinewave of twice frequency, half amplitude and with d-c offset [$(\sin^2 x = 1/2\ (1-\cos 2x)$]. To operate, turn the AM/FM LEVEL control full ccw, null the carrier with the CARRIER LEVEL control, then increase the AM/FM close to a maximum unclipped level. The output sinewave will be double frequency with the positive peaks of the waveform at 0 volts

dc. This offset may be balanced out by use of the OFFSET control.

## 2-3. SPECIAL APPLICATIONS OF EXT AM MODE

If a d-c voltage is applied to the EXT AM port and the CARRIER LEVEL control is set for a convenient carrier magnitude, variation of the d-c voltage will effect a voltage control of amplitude at the main output with a 100:1 amplitude range. Required polarity of the d-c voltage depends on the carrier phase selected by the CARRIER LEVEL control. If a sinewave, having d-c offset with negative (or positive) peaks at 0 volts dc, is applied to the EXT AM port, and the carrier has been nulled with the CARRIER LEVEL control, an a-m waveform of 100 percent modulation will be produced whose amplitude is controlled by rotation of the AM/FM LEVEL control.




**AM Input Conn.**
Signals applied here are the amplitude modulation inputs for the carrier created by the internal generator.

**FM Input Conn.**
Provides external voltage control of output frequency over 1000:1 range. Identical to VCG input in F32, F33, F34.

**AM/FM Level**
Controls amplitude of signal applied to AM or FM input connectors. Sets desired maximum VCA voltage for 100% attenuation and maximum p-p modulated signal amplitude.

**OUTPUT Conn.**
Provides 50 ohm output for all waveforms.

**CARRIER Level**
Controls the amplitude and phase (relative to the carrier sync) of the carrier wave.

**MODULATION Switch**
Rotary switch selects one of the six modulation functions of the instrument. In OFF position, the generator is equivalent to the basic SERIES 30 generators.

**CARRIER SYNC OUT Conn.**
Provides a sinewave output which may be used for demodulation applications.

**Figure 2-1. Front Panel Controls**

NOTES

# Section 3

# CIRCUIT DESCRIPTION

## 3-1. INTRODUCTION

Figure 3-1 is a simplified block diagram of the modulator subassembly board A2. (A complete schematic is shown at the back of this supplement as Figure 6-1.) The modulator circuitry is active in the EXT AM, INT AM, and 2X FREQ modes only. The waveform appearing at the WAVEFORM switch is wired around the modulator assembly in all other modes.

## 3-2. MODULATOR

The modulator is an integrated circuit (IC1) containing two differential pairs and two current controls wired as a balanced modulator. Pins IC1-8 and 10, the base connections to the differential pairs, are driven by the main oscillator of the instrument. Pin 10 accepts the waveform unmodified; pin 8 receives the d-c average of the waveform. The modulating signal is introduced on pin 1, which is the current control for one differential pair. A d-c level obtained from front panel control R14, CARRIER LEVEL, is applied to the current control of the second differential pair. The differential output of IC1 appears on pins 6 and 12, riding on a d-c level of about +12 volts. Q1 and Q2 are emitter followers used to drive the amplifier.

## 3-3. AMPLIFIER

A noninverting differential amplifier (Q4 through Q8) having a gain of approximately 5 is required to (1) restore the gain loss in the modulator chip, (2) shift operating baseline from +12 volts at the modulator output (IC1 pins 6 and 12) to 0 volts dc, (3) provide common mode rejection for modulator drift, and (4) provide a low-impedance transmission line drive to the output amplifier of the generator.

## 3-4. 400-Hz OSCILLATOR

A Wein-bridge oscillator is implemented using operational amplifier IC2. The tuning elements are series C13 and R41, and parallel C12 and R39. Diodes CR5 and CR6 provide nonlinear gain elements. R40 is the amplitude adjustment. When the generator is used in the d-c mode and the MODULATION switch is inadvertently left in INT AM, noise will appear on the OUTPUT port. Q9 is provided to stop the oscillator whenever a logic signal appears on E5 or E6 causing Q9 to conduct.

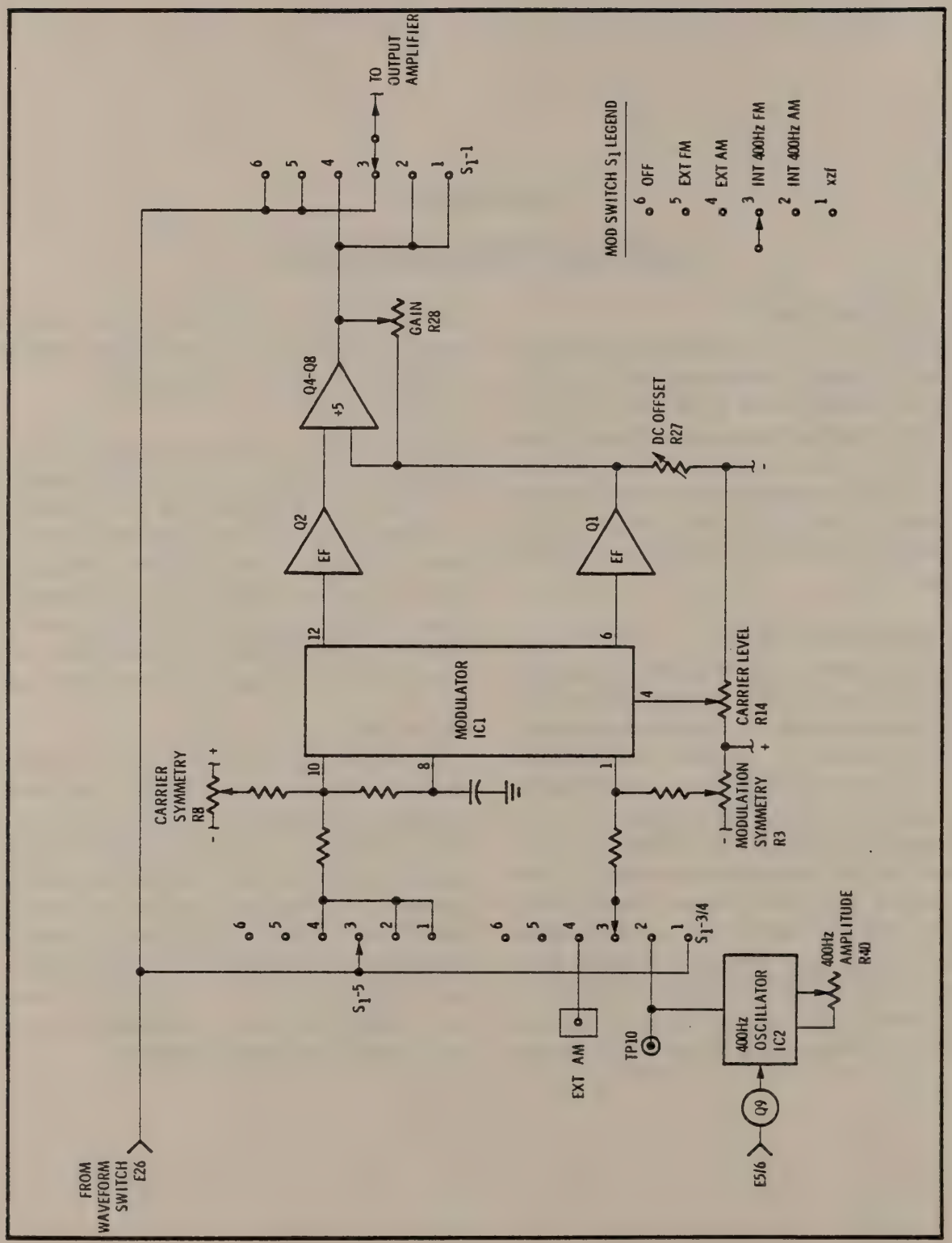



Figure 3-1. Simplified Block Diagram

# Section 4

# CALIBRATION PERFORMANCE

## 4-1. INTRODUCTION

This section contains the procedures for checking your SERIES 30 F35 or F36 function generator for proper operation and/or for calibrating all elements of the instrument.

## 4-2. CALIBRATION/PERFORMANCE-TESTS

The sequence and methods of testing and calibrating the modulation section of the instrument are given in table 4-1 below. The necessary equipment is the same as that indicated in Section 4 of the basic SERIES 30 Instruction Manual.

**TABLE 4-1. CALIBRATION AND PERFORMANCE CHECK PROCEDURE**
**(A2 Card unless otherwise specified)**

| Step | Calibration | Control Setting | Test Equipment and Procedure |
|---|---|---|---|
| 1.0 | DC OFFSET | FREQ Mult @ 100K<br>DIAL @ 1.0<br>MODE @ Cont<br>WAVEFORM @ ∿<br>AM/FM LEVEL @ CCW Stop<br>MODULATION @ EXT AM<br>AMPLITUDE @ 10v p-p<br>LEVEL @ CW Stop | 1. Scope and DVM on OUTPUT BNC (term 50 ohms)<br>2. Adjust CARRIER LEVEL for null < 50mv p-p |
| | | WAVEFORM to DC | 3. Adjust R27 for offset 0 to -50mv dc (-100mv cold) |
| 2.0 | GAIN | WAVEFORM to ∿<br>CARRIER LEVEL @ CW Stop | 1. Adjust R28 for 10v +0.20 -.0v p-p<br>2. Readjust DC Offset per Step 1.0 above |
| 3.0 | AMPLITUDE MOD. | FREQ. MULT @ 1M | 1. Adjust CARRIER LEVEL to produce 5v p-p |

**TABLE 4-1. CALIBRATION AND PERFORMANCE CHECK PROCEDURE (Continued)**
**(A2 Card unless otherwise specified)**

| Step | Calibration | Control Setting | Test Equipment and Procedure |
|---|---|---|---|
| | | | 2. Apply 10v p-p sinewave @400 Hz to AM BNC CAUTION: This signal must not have d-c offset greater than 0 ±0.01 volts.<br>3. Increase AM/FM LEVEL and adjust CARRIER LEVEL to obtain 100% modulated waveform @ 10v p-p min. without clipping.<br>4. Adjust R8 for approximate modulation symmetry |
| 3.2 | SUPPRESSED CARRIER MOD. | AM/FM LEVEL to CCW Stop | 1. Adjust CARRIER LEVEL for null ( < 100mv p-p)<br>2. Increase AM/FM LEVEL to obtain > 10v p-p unclipped suppressed carrier waveform<br>3. Adjust R3 and R8 for modulation symmetry |
| 4.0 | 400-Hz INTERNAL MODULATION | | |
| 4.1 | AMPLITUDE & FREQUENCY | Modulation @ INT 400 Hz AM | 1. Connect Scope to TP1. (unterm.)<br>2. Adjust R40 for unclipped waveform. > 10v < 12v p-p.<br>3. Check frequency for 400 ±40 Hz |

**TABLE 4-1. CALIBRATION AND PERFORMANCE CHECK PROCEDURE (Continued)**
**(A2 Card unless otherwise specified)**

| Step | Calibration | Control Setting | Test Equipment and Procedure |
|---|---|---|---|
| 4.2 | MODULATION | | 1. Scope to main OUTPUT BNC (term 50Ω)<br>2. Repeat step 3.1. Observe 400 Hz modulated carrier at 10.0 v p-p main.<br>3. Repeat step 3.2. Observe 10v suppressed carrier waveform |
| 4.3 | FM | Modulation @ INT<br>400 Hz FM | 1. Vary AM/FM LEVEL and check for proper f-m modulation of output waveform |

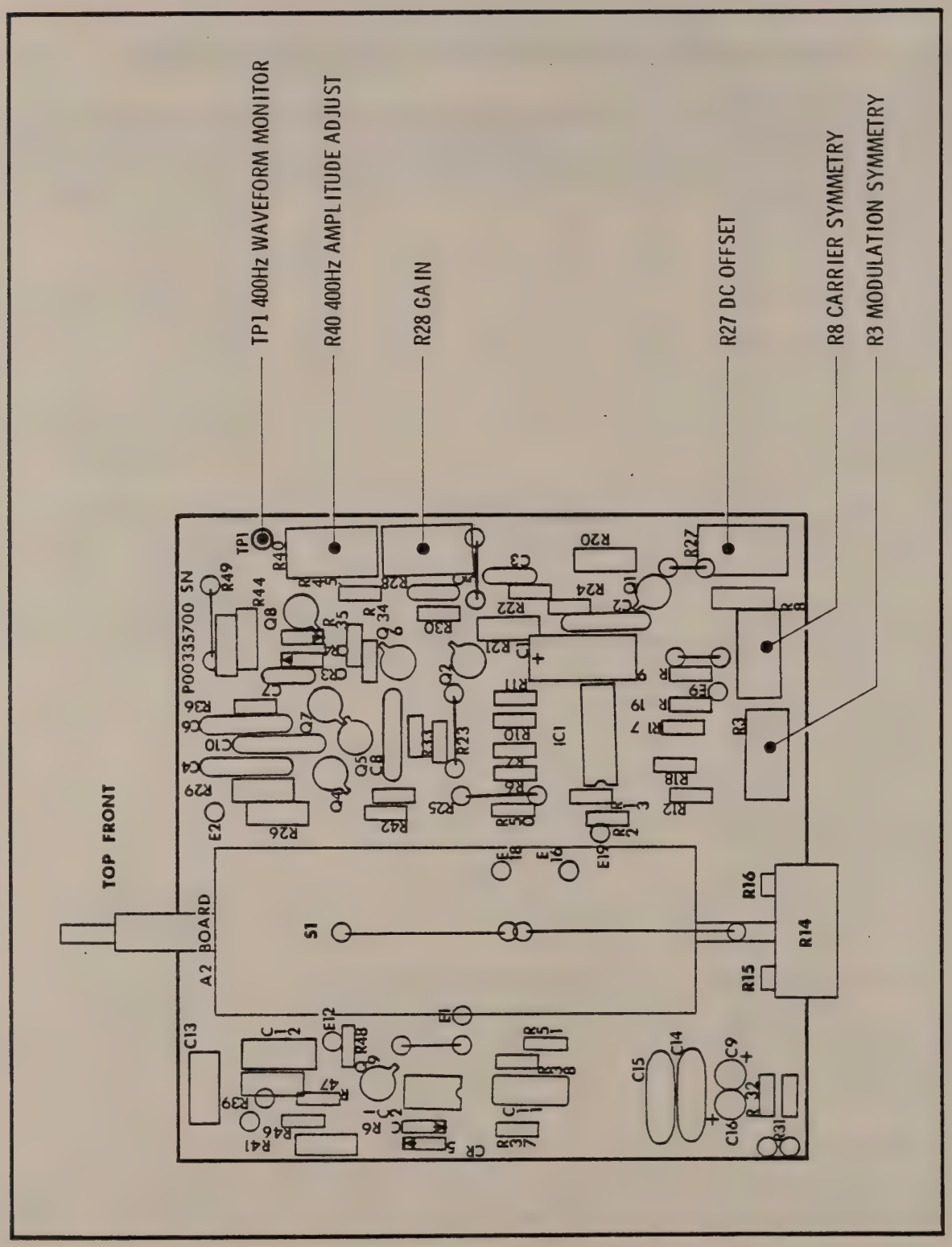



Figure 4-1. Adjustment Location Diagram

# Section 5
# PARTS LIST

## 5-1. INTRODUCTION

All electrical and electronic parts are identified here, together with the manufacturers, whose code numbers are given in Table 6-1 of the basic SERIES 30 Instruction Manual.

## 5-2. PARTS LIST

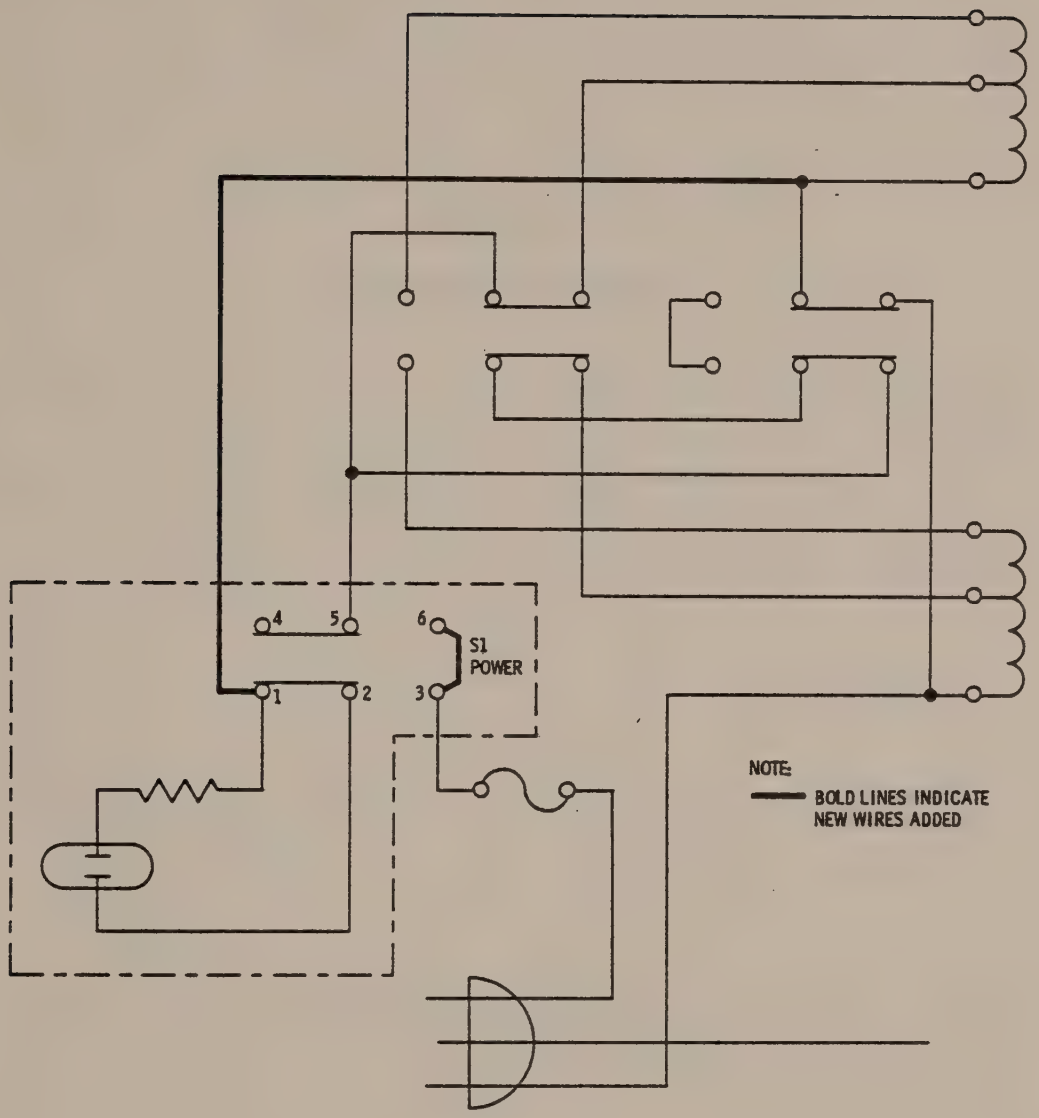
Parts are listed by circuit reference number providing (a) value, (b) description, (c) manufacturer's code symbol, and (d) original manufacturer's part number in Table 5-1 below.

**TABLE 5-1. PARTS LIST**

| REF DESIG | VALUE | DESCRIPTION | IEC P/N | MFR | MFR P/N |
|---|---|---|---|---|---|
| C1 | 150 uF | C: Electrolytic 6 volts ±10% | | 56289 | 150D157X0006RD |
| C2 | 0.1 uF | C: Dip Mylar 50 volts ±40% | | 07994 | FM0104U |
| C4, C6 | 0.1 uF | C: Dip Mylar 50 volts ±40% | | 07994 | FM0104U |
| C7 | .001 uF | C: Ceramic 1000 volts ±20% | | 56289 | C016A102G102M |
| C8 | 0.1 uF | C: Dip Mylar 50 volts ±40% | | 07994 | FM0104U |
| C9 | 6.8 uF | C: Electrolytic, 35 volts ±20% | | 56289 | 150D225X0020A2 |
| C10 | 0.1 uF | C: Dip Mylar 50 volts ±40% | | 07994 | FM0104U |
| C11 | 0.22 uF | C: Metallized Polyester 250 volts ±10% | | | C280AE/P220K |
| C12, C13 | .0047 uF | C: Polyester Film 200 volts ±5% | | 56289 | 410P4755 |
| C14, C15 | 0.1 uF | C: Dip Mylar 50 volts ±40% | | 07994 | FM0104U |
| C16 | 6.8 uF | C: Electrolytic, 35 volts ±20% | | 56289 | 150D225X0020A2 |
| CR3, CR4 | | Diode: Silicon | | 03508 | IN645 |
| CR5, CR6 | | Diodc. Silicon | | 03508 | IN914A |
| IC1 | | Integrated Circuit: MC1496L 14-Pin Dip | | 04713 | MC1496L |
| IC2 | | Integrated Circuit: 741 8-Pin Dip | | 01295 | 72741P |
| Q1,2,4 | | Tstr: Silicon NPN | | 04713 | 2N3904 |
| Q5 | | Tstr: Silicon PNP | | 07263 | 2N4258 |
| Q6 | | Tstr: Silicon NPN | | 04713 | 2N3904 |
| Q7 | | Tstr: Silicon PNP | | 04713 | 2N3906 |
| Q8 | | Tstr: Silicon NPN | | 04713 | 2N3904 |
| Q9 | | Tstr: Silicon PNP | | 04713 | 2N3906 |

## TABLE 5-1. PARTS LIST (Continued)

| REF DESIG | VALUE | DESCRIPTION | IEC P/N | MFR | MFR P/N |
|---|---|---|---|---|---|
| R1 | 2.5K | R: Variable W/A1 S4, A1 R133 | | 07421 | PR0347918A |
| R2 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG1/4 - 472J |
| R3 | 100K | R: Variable 1/4 Watt ±30% | | 71590 | TSV-100K |
| R6 | 1.1K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 112J |
| R7 | 2 K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 202J |
| R8 | 100K | R: Variable 1/4 Watt ±30% | | 71590 | TSV-100K |
| R9 | 47K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 473J |
| R10, R11 | 51 | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 510J |
| R12 | 47K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 473J |
| R13 | 1K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 102J |
| R14 | 10K | R: Variable P/O S1 | | 07421 | PR0347917A |
| R15, R16 | 1.37K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-1371F |
| R17 | 220 | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 221J |
| R18 | 510 | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 511J |
| R19 | 1.81K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 182J |
| R20, R21 | 499 | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-4990F |
| R22, R23 | 5.1K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 512J |
| R24, R25 | 1K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 102J |
| R26 | 499 | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-4990F |
| R27, R28 | 1K | R: Variable 1/4 Watt ±30% | | 71590 | TSV-1K |
| R29 | 499 | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-4990F |
| R30 | 2K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 202J |
| R31, R32 | 11 Ω | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 110J |
| R33 | 62 | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 620J |
| R34, R35 | 6.2 Ω | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 6R2J |
| R36 | 62 | R: Metal Galze 1/4 Watt ±5% | | 75042 | RG 1/4 - 620J |
| R37 | 470 | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 471J |
| R38 | 10K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 103J |
| R39 | 84.5K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-8452F |
| R40 | 50K | R: Variable 1/4 Watt ±30% | | 71590 | TSV-50K |
| R41 | 84.5K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-8452F |
| R42 | 1.6K | R: Metal Glaze 1/4 Watt ±5% | | 75042 | RG 1/4 - 162J |
| R43 | 3.74K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-3741F |
| R44 | 1.21K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-1211F |
| R45 | 2K | R: Metal Glaze, 1/4 Watt ±5% | | 75042 | RG 1/4 - 202J |
| R49 | 2.21K | R: Metal Film 1/2 Watt ±1% | | 01295 | MC60D-2211F |
| R50, R51 | 2K | R: Metal Glaze, 1/4 Watt ±5% | | 75042 | RG 1/4 - 202J |
| S1 | | Switch: Rotary, w/R14 | | 07421 | PR0347917C |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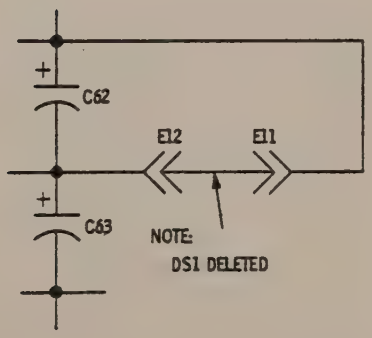
5
6
S1
POWER
1
2
3
NOTE:
BOLD LINES INDICATE
NEW WIRES ADDED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NOTE:
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# Section 5

# MAINTENANCE

## 5-1. INTRODUCTION

This section of your SERIES 30 manual was prepared with service personnel in mind. Accordingly, the schematic diagram at the back of the manual provides waveform information at critical points in the instrument to aid in diagnosing instrument failures. Figures 5-1 through 5-4 are switch assembly diagrams, and the Troubleshooting Guide (table 5-1) provides detailed information for a number of possible malfunctions. Logic and Start-Stop timing diagrams are shown in figure 3-2, Section 3.

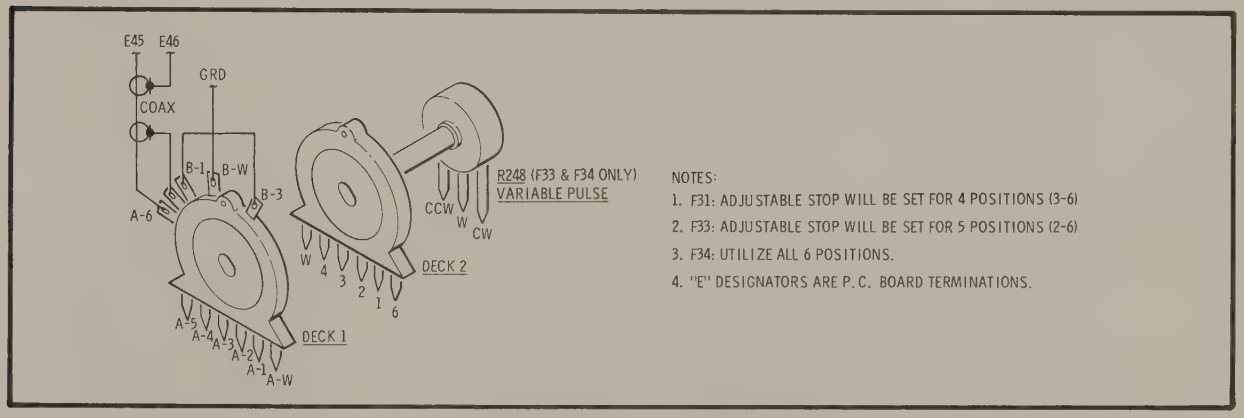



**Figure 5-1. Waveform Switch (S3)**

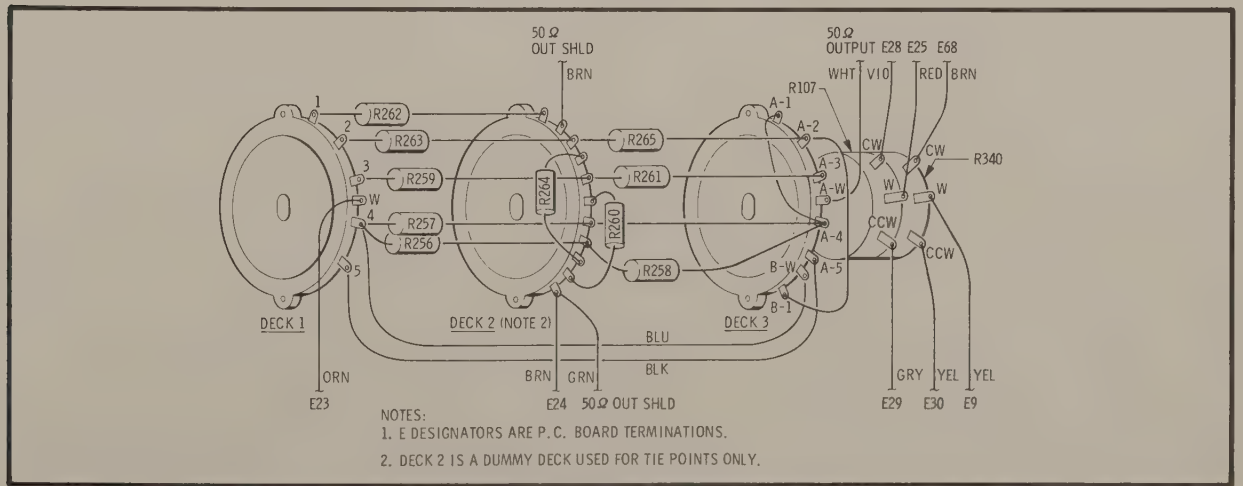



**Figure 5-2. Attenuator Switch (S5)**

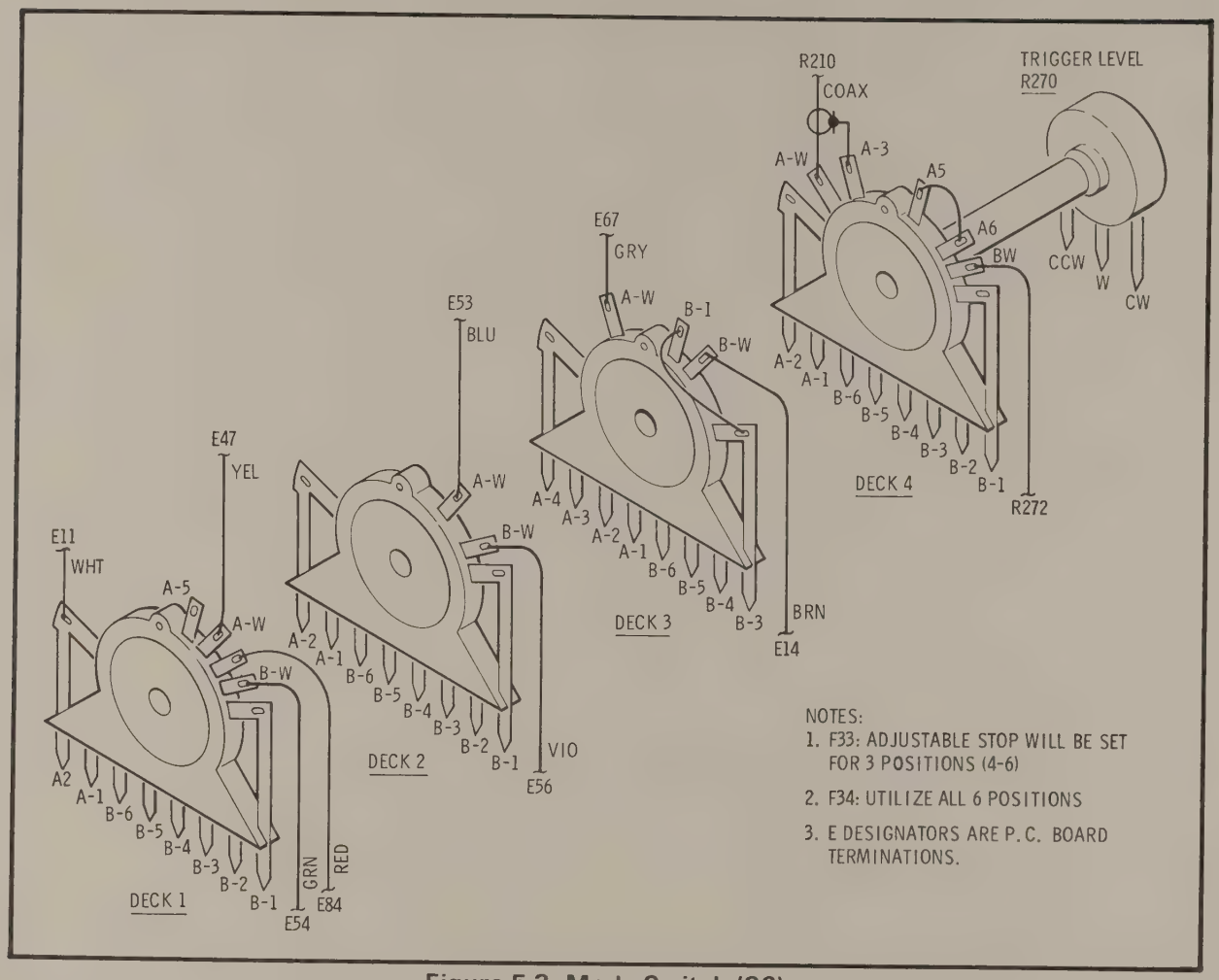



**Figure 5-3. Mode Switch (S6)**

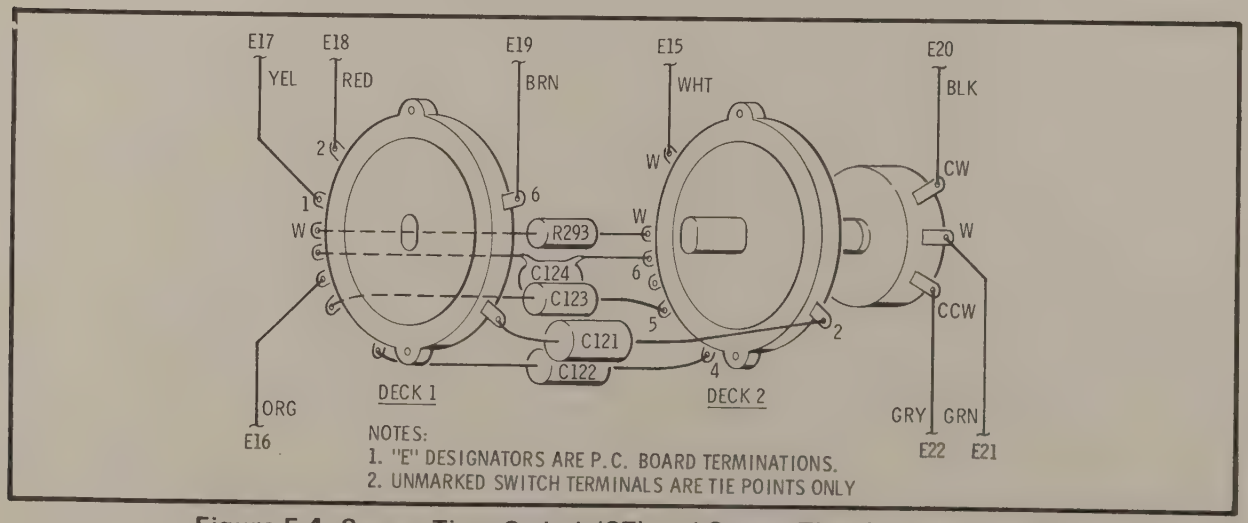



**Figure 5-4 Sweep Time Switch (S7) and Sweep Time Vernier (R287)**

## TABLE 5-1. TROUBLESHOOTING GUIDE

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| 1. NO OUTPUT | | |
| a. For all waveform positions | 1. Output amp disabled. | See step 14. |
| | 2. Power supply disabled. | See step 20. |
| b. For all waveform positions except (offset) dc | Triangle loop stalled. | See steps 15 and 4b. |
| c. No sine waveform output | Sine shaper disabled. | See step 21. |
| d. No square output | 1. Short to ground between CR19 cathode and Q7 or Q8 base. | |
| | 2. Open CR19 or CR21, R61, R62 or R63. | |
| | 3. Open R64 or R65, Q7 or Q8. | |
| e. No offset capability | S4 not functioning (always closed). | |
| f. No variable pulse (33, 34) | 1. Variable pulse circuit disabled. | See step 24. |
| | 2. Wiper of R248 shorted to ground. | |
| g. No sweep (F34) | 1. Switch not in SWP mode position. | |
| | 2. Logic "0" from S6-2B wiper. | See step 22. |
| 2. NO SYNC OUT, Loop Functioning | 1. Open circuit between TP13 and Sync Out BNC. | |
| | 2. Short to ground between R44 and Sync Out BNC. | |
| 3. NO FREQ ANALOG OUT (F34) | 1. Faulty IC-17. | |
| | 2. Open circuit between IC17-6 and Analog Out BNC. | |
| 4. OUTPUT LEVEL Improper | | |
| a. Low amplitude | 1. Output amp faulty. | See step 14. |
| | 2. Misadjusted R166. | |
| | 3. Failure in attenuator S5. | Check attenuator calibration. |
| | 4. Failure in LEVEL potentiometer (R107). | |
| b. Large d-c Offsets | 1. S4 failure. | |
| | 2. Misadjusted R119. | |
| | 3. Output amplifier faulty. | See part 14. |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| 5. OUTPUT WAVEFORMS IMPROPER | | |
| a. Time nonsymmetry at all dial frequencies ( Δ, ∿, ⎍ ). | 1. R18, R205 or R1 misadjusted.<br>2. Current control problems. | <br>See step 18. |
| b. Time nonsymmetry at low dial frequencies ( Δ, ∿, ⎍ ). | 1. R18 misadjusted.<br>2. Current control problems.<br>3. Leaky Q2 or Q3 (collector to base).<br>4. Leaky CR58 or Q4.<br>5. Shorted or leaky CR4, CR5, CR8 or CR9. | <br>See step 18. |
| c. Amplitude, nonsymmetry. | 1. R54 misadjusted.<br>2. VLS faulty. | <br>See step 16. |
| d. All waveforms clipped. | Output amplifier faulty. | See part 14. |
| e. Sine and Triangle waveforms clipped. | Misadjusted R29. | |
| f. Sinewave only clipped. | 1. Sine shaper or sine amplifier faulty.<br>2. Sine shaper calibration. | See step 21. |
| g. Squarewave clipped. | VLS faulty. | See step 16. |
| h. Nonlinear triangle in all FREQ MULT positions. | Leaky components: CR9, CR8, CR4, CR5, CR58, Q2 (C to B) or Q3 (collector to base). | |
| i. Nonlinear triangle in specific FREQ MULT positions. | C1, C2, C3, C4, or C5. | |
| j. Excessive overshoot or ringing on squarewave. | 1. Output amplifier trouble.<br>2. Open C52, C54, C56, or C57. | See step 14. |
| k. Excessive rise and fall times on variable pulse. | Variable pulse rise and fall excessive (F33, F34). | See step 24. |
| l. Excessive sine distortion. | 1. Improper triangle input level, amplitude symmetry, time symmetry, or linearity.<br>2. Sine shaper calibration improper.<br>3. Sine shaper faulty. | See step 4.<br><br>See step 21. |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| m. AM or FM on output. | 1. Power supply ripple. | See step 20. |
| | 2. Frequency control oscillations. | See step 19. |
| | 3. Current control oscillations. | See step 18. |
| | 4. Misadjusted R203 (F34). | |
| 6. FREQENCY CALIBRATION IMPROPER | | |
| a. Large freqency error in specific FREQ mult position. | 1. Faulty C1 through C4. | |
| | 2. Faulty S2 contact. | |
| b. Large freq. error in all FREQ mult positions. | 1. Q4 open drain. | |
| | 2. VLS faulty (C25 shorted) | See step 16. |
| | 3. Misadjusted R5 or tuning assy out of alignment. | |
| | 4. IC4 faulty. | |
| | 5. Frequency Control faulty. | See step 19. |
| | 6. Current Control faulty. | See step 18. |
| 7. INSUFFICIENT FREQ RANGE | | |
| a. <1000: 1 VCG | 1. Misadjustment of R205 and R1. | |
| | 2. Failure in frequency control section. | |
| | 3. Misadjustment of R5, or tuning assembly out of mechanical alignment. | |
| b. <1000:1 Sweep | 1. Misadjustment of R205 and R1. | |
| | 2. Failure in frequency control section. | |
| | 3. Misadjustment of R5 or R210, or tuning assembly out of mechanical alignment. | |
| c. <1000:1 Dial Range | 1. Misadjustment of R205 and R1. | |
| | 2. Misadjustment of R5 or tuning assembly out of mechanical alignment. | |
| | 3. Failure in frequency control section. | See step 19. |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| 8. OUTPUT LIMIT LIGHT FAULTS (F32 thru F34) | | |
| a. On prematurely | 1. Misadjustment of R166. | |
| b. On always | 1. Q49 shorted.<br>2. Q48 open. | |
| c. Off always | 1. Lamp failure.<br>2. Q49 open.<br>3. Q48 shorted.<br>4. IC 18 faulty. | |
| 9. GATE MODE FAULTS (F33/F34) | | |
| a. No dynamic gating | 1. Trig level pot open circuit to ±15v.<br>2. Open circuit from TRIG/SYNC BNC to R277.<br>3. S9 faulty, open circuit to ground.<br>4. S6-2A, 4B open.<br>5. Logic trouble.<br>6. Start/Stop trouble. | <br><br><br><br>See step 22.<br>See step 23. |
| b. No manual gating | 1. S9 faulty.<br>2. 1 and 4 from 9a above. | |
| c. Incomplete last cycle | 1. S6 - 1B open.<br>2. Logic trouble.<br>3. Start/Stop trouble. | <br>See step 22.<br>See step 23. |
| d. Baseline of triangle and sine offset from zero. | 1. R228 misadjusted.<br>2. Start/Stop trouble. | <br>See step 23. |
| e. Baseline oscillation | Start/Stop trouble. | See step 23. |
| 10. TRIGGER MODE FAULTS (F33/F34) | | |
| a. Double triggers or Incomplete cycle. | 1. Start/Stop trouble.<br>2. Logic trouble. | See step 23.<br>See step 22. |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| b. Base line of triangle and sine offset from zero. | Misadjustment of R228. | |
| c. No dynamic triggering. | Same as 9a. | |
| d. No manual triggering. | Same as 9b. | |
| e. Baseline oscillations. | Start/Stop trouble. | See step 23. |
| 11. BURST MODE FAULTS. | | |
| a. No burst output. | 1. Open circuit from TP27 to R277 when in burst mode.<br>2. Same as 9a. | |
| b. Continuous output only. | Same as 9a. | |
| 12. SWEEP FAULTS | | |
| a. Waveform nonlinearity. | 1. Q61, Q64, Q65 leaky.<br>2. CR73, CR74, CR75 leaky.<br>3. C121-C125 leaky. | |
| b. Vernier <100:1 sweep time range. | IC15 faulty. | |
| c. No Sweep | Same as 1g. | |
| 13. TRIGGERED SWEEP FAULTS | | |
| a. No sweep. | Same as 1g. | |
| b. Double sweep. | Excessive rate on TRIG/SYNC input. | |
| c. Interrupted sweep. | 1. Q63 failure.<br>2. Logic Failure. | See step 22. |
| 14. OUTPUT AMP FAULTS | | |
| a. Positive Output (<11v open circuit) at all times. | 1. Q33, Q17, CR31 or CR32 open.<br>2. Negative supply not operating.<br>3. VR7 shorted.<br>4. IC9 faulty. | |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| b. Negative output (<-11 open circuit) at all times. | 1. Q18, or VR7 open.<br>2. Negative regulated supply not operating.<br>3. IC9 faulty. | |
| c. Small offsets only. | 1. IC9 faulty.<br>2. Q17 shorted base to emitter or open collector. | |
| d. Clipped waveforms. | 1. Q19 or Q20 open.<br>2. IC9 faulty. | |
| e. Oscillations. | 1. C55 or C53 open.<br>2. C58 misadjusted.<br>3. C56, C59, C57, or C52 open.<br>4. Feedback path partially shorted: R166 or R132. | |
| f. Squarewave for all Waveforms positions, saturating at both ends. | Feedback path open: R166 or R132 open. | |
| g. Low amplitude | 1. Feedback path shorted or partially shorted: R166, R132.<br>2. Q18 or IC9: low current gain. | |
| h. 0v Output | C58 shorted. | |
| 15. TRIANGLE LOOP INOPERATIVE | | |
| a. Squarewave locked up @ +3v @ TP16 or Triangle locked up @ >+3v @ TP19. | 1. IC5 faulty.<br>2. Q9 or Q6 open.<br>3. CR11, CR12, CR13 or CR14 open. | |
| b. Squarewave locked up at -3v @ TP16 or Triangle locked up >-3v @ TP19. | 1. IC5 faulty.<br>2. Q9 or Q6 open.<br>3. CR11, CR12, CR13, or CR14 open. | |
| c. Squarewave locked up @ ±3v @ TP16 or Triangle locked up ≈0v. | 1. C1, C2, C3, C4, C5, C6, C8, C9, C10, or C14 shorted to common.<br>2. IC4 faulty.<br>3. TP9 or junction of R12 and R13 shorted to common. | |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| d. Both squarewave and triangle wave at ≈ 0v. | Power supply disabled. | See step 20. |
| 16. VLS FAULTS | | |
| a. TP16 @ +3v and TP13 @ +5v always. | 1. Q9 open collector or base-emitter short.<br>2. IC5-9 does not go to + logic level (≈3v): faulty IC or no input.<br>3. Q6 open.<br>4. Q5 or Q10 shorted.<br>5. TP19 open circuit.<br>6. TP13 open. | |
| b. TP16 @ -3v and TP13 @ -5v always. | 1. Q9 shorted.<br>2. IC5-9 does not go to - 10gic level (≈1v), or no input.<br>3. CR17 open.<br>4. TP19 jumper open circuit.<br>5. TP13 jumper open circuit. | |
| 17. FOLLOW AMPLIFIER | | |
| a. TP19 @ +5v. | 1. IC4 faulty.<br>2. Q4 shorted (drain to source)<br>3. Q21 or R29 open. | |
| b. TP19 @ more negative than -5v. | 1. IC4 faulty.<br>2. Q4 open.<br>3. Q21 shorted. | |
| c. TP19 between +3v and -3v. | 1. IC4 faulty.<br>2. Short to ground, from E49 to S3. | |
| 18. CURRENT CONTROL DISABLED | | |
| a. Set FREQ dial @ 3.0 and short TP17 to ground for test. Voltage @ CR9 cathode <330mv Voltage @ CR4 cathode +5v. | 1. Q2 open.<br>2. IC2 faulty.<br>3. Voltage across R15 less than 5.8v: (a) IC1 faulty or Q1 open; (b) voltage at TP8 improper. FREQ Control faulty. | See step 19. |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| b. Set FREQ dial @ 3.0 and short TP17 to ground for test. Voltage @ CR9 cathode less negative than -330 mv. Voltage @ CR4 cathode -5v. | 1. Q3 open.<br>2. IC2 faulty.<br>3. Voltage across R16 less than 5.8v: Voltage at TP8 improper. FREQ Control faulty. | See step 19. |
| 19. FREQUENCY CONTROL<br>a. TP8 less negative than TP9 when FREQ Dial @ CW Stop. | 1. Q59 open.<br>2. IC12 faulty.<br>3. R1 open or misadjusted.<br>4. R5 misadjusted or tuning assembly out of mechanical alignment. | |
| b. Dial Linearity poor @ Top of FREQ Dial. | Q50 open collector. | |
| 20. POWER SUPPLY<br>a. Entirely dead. | 1. Fuse blown.<br>2. S1, S8 open. | |
| b. All voltages too high. | 1. IC10 open.<br>2. R145 open.<br>3. VR4, Q23, Q24 shorted.<br>4. VR2 open. | |
| c. All voltages too low. | 1. VR2 shorted.<br>2. VR4 open. | |
| d. No regulated voltages. | 1. Q25 shorted.<br>2. Q23, Q24 open. | |
| e. No negative regulated voltages. | 1. Q28, Q29 open.<br>2. Q30 short.<br>3. IC11 open. | |
| f. +5v too high. | Q26, Q27 short. | |
| g. +5v too low. | Q26, Q27 open. | |
| h. -5v too high. | Q31, Q32 shorted. | |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| i. -5v too low. | Q31, Q32 open. | |
| 21. SINE SHAPER FAULTS | | |
| a. Sine Amplifier no output. | 1. IC6 faulty.<br>2. VR1 faulty.<br>3. C43 shorted. | |
| b. Excessive distortion. | 1. IC6 faulty.<br>2. Open diode in IC7 or IC8.<br>3. CR29, CR30 shorted.<br>4. Open resistor in R100 or R101. | |
| c. Clipped Waveforms. | 1. Open CR29, CR30.<br>2. Q11, Q12, Q15, Q16 faulty.<br>3. Q13, Q14 shorted. | |
| 22. LOGIC FAULTS | | |
| a. Logic "0" at TP30 in CONT mode. | 1. Open CR53.<br>2. Short to ground at CR54, CR68, CR69 or S6-1B. | |
| b. Logic "0" always at TP30 in GATE, BURST and SWP CONT modes. | 1. IC14 faulty.<br>2. IC13 faulty.<br>3. S9 faulty. | |
| 23. START-STOP FAULTS | | |
| a. No Gating. | 1. Q52 open.<br>2. Open circuit between E47 and TP25. | |
| b. Incomplete last Triangle Cycle. | CR56 open. | |
| c. Loop Stalled Negative @ TP13. | 1. Q52, Q53 or Q54 shorted.<br>2. Q55 open. | |
| d. Loop Stalled Positive @ TP13. | CR58 shorted. | |

**Table 5-1. Troubleshooting Guide (Continued)**

| Symptom/Step | Possible Cause | Remarks |
|---|---|---|
| 24. VARIABLE PULSE FAULTS | | |
| a. Output at +5v. | 1. Q57, Q60 shorted.<br>2. Q59, Q58 or CR61 open. | |
| b. Output at -5v. | 1. Q58, Q59 shorted.<br>2. Q57, Q60 or CR62 open. | |

# Section 6
# PARTS LIST

## 6-1. INTRODUCTION

This section contains information for identifying and ordering replacement parts. Replacement parts may be ordered from Interstate Electronics Corporation. Be certain that the order or inquiry identifies the part by description and part number.

Table 6-1 is a listing of all manufacturers supplying parts used in the function generator. Manufacturers are listed numerically by their respective code symbols.

## 6-2. PARTS LIST TABLES

Table 6-2 lists all electrical and electronic parts in alphanumeric order by reference designators and provides the following information for each part, where applicable: (a) value, (b) description, (c) manufacturer's code symbol, and (d) original manufacturer's part number.

**TABLE 6-1. LIST OF MANUFACTURERS**

| Code | Manufacturer |
|---|---|
| 01295 | Texas Instruments Inc., Dallas, Texas |
| 02735 | RCA Corporation, Somerville, N.J. |
| 04713 | Motorola Semiconductor Products Inc., Phoenix, Arizona |
| 07263 | Fairchild Camera and Instrument Corporation, Mountain View, California |
| 07421 | Interstate Electronics Corporation, Anaheim, California |
| 07994 | American Radionic Co., Danbury, Connecticut |
| 13103 | Thermalloy Co., Dallas, Texas |
| 18324 | Signetics Corp., Sunnyvale, California |
| 22753 | UID Electronics, Hollywood, Florida |
| 28480 | Hewlett-Packard Co., Palo Alto, California |
| 56289 | Sprague Electric Co., North Adams, Massachusetts |
| 71590 | Centralab, Milwaukee, Wisconsin |
| 74950 | E. F. Johnson Co., Waseca, Minnesota |
| 75042 | I R C Inc., Philadelphia, Pennsylvania |
| 75915 | Littelfuse Inc., Des Plaines, Illinois |
| 76433 | General Instrument Corporation, Newark, New Jersey |
| 76493 | J. W. Miller Co., Los Angeles, California |
| 80740 | Beckman Instruments, Fullerton, California |
| 82389 | Switchcraft Inc., Chicago, Illinois |
| 84171 | Arco Electronics Inc., Great Neck, New York |
| 90201 | Mallory Capacitor Co., Indianapolis, Indiana |

## TABLE 6-2. PARTS LIST

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| C1-C4 | 820pf | C: Metal Mylar 1% Matched Set | 07421 | P00347750 |
| C5 | 820pf | C: Mica 500 volts ±5% | 84171 | CM06CC821J |
| C8-C9 | 2.4-24.5pf | C: Variable Air Dielectric | 74970 | 189-509-5 |
| C10 | 43pf | C: Mica 500 volts ±10% | 84171 | CM05ED430K |
| C12 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C13 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C14 | 18pf | C: Mica 500 volts ±10% | 84171 | CM05ED180K |
| C15 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C16 | 3.3pf | C: Ceramic 1000 volts ±0.5pf | 56289 | C030A102E3R3D |
| C17 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C18 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C19 | 12pf | C: Mica 500 volts +0.5 pf -0.5pf | 84171 | CM05ED120D |
| C21 | 68pf | C: Mica 500 volts ±5% | 84171 | CM05ED680J |
| C22 | 3.3pf | C: Ceramic 1000 volts ±0.5pf | 56289 | C030A102E3R3D |
| C23 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C24 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C25 | 2.4-24.5pf | C: Variable Air Dielectric | 74970 | 189-509-5 |
| C26 | 47pf | C: Mica 500 volts ±10% | 84171 | CM05ED470K |
| C27 | 36pf | C: Mica 500 volts ±10% | 84171 | CM05ED360K |
| C30 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C31 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C35 | 5pf | C: Mica 500 volts ±10% | 84171 | CM05CD050K |
| C36 | 6.8pf | C: Tant E1 35 volts ±10% | 71590 | 196D685X0035KA1 |
| C42 | 3.3pf | C: Ceramic 1000 volts ±0.5pf | 56289 | C030A102E3R3D |
| C43 | 2.4-24.5pf | C: Variable Air Dielectric | 74970 | 189-509-5 |
| C44 | 510pf | C: Mica 500 volts ±10% | 84171 | CM05ED511K |
| C45 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C46 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C48 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C52 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C53 | 200pf | C: Mica 500 volts ±10% | 84171 | CM05ED201K |
| C54 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C55 | 130pf | C: Mica 500 volts ±10% | 84171 | CM05ED131K |
| C56 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C57 | 0.1µf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C58 | 1.8-16.7pf | C: Variable Air Dielectric | 74970 | 189-506-5 |
| C59 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C62 | 2500µf | C: Electrolytic 35 volts -10% +150% | 76433 | 2407044 |
| C63 | 2500µf | C: Electrolytic 35 volts -10% +150% | 76433 | 2407044 |
| C64 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C65 | 100µf | C: Electrolytic 50 volts -10% +100% | 90201 | MTV20-44818 |
| C66 | 100µf | C: Electrolytic 15 volts -10% +100% | 90201 | MTV20-44823 |
| C67 | 0.01µf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C68 | 100µf | C: Electrolytic 50 volts -10% +100% | 90201 | MTV20-44818 |

## Table 6-2. Parts List (Continued)

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| C69 | 100μf | C: Electrolytic 15 volts -10% +100% | 90201 | MTV20-44823 |
| C70 | 0.1μf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C71 | 0.1μf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C72 | 0.1μf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C102 | 15pf | C: Mica 500 volts ±10% | 84171 | CM05CD150K |
| C103 | 47pf | C: Mica 500 volts ±10% | 84171 | CM05ED470K |
| C105 | 0.01μf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C106 | 20pf | C: Mica 500 volts ±10% | 84171 | CM05ED200K |
| C110 | 0.01μf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C111 | 0.1μf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C112 | 150pf | C: Mica 500 volts ±10% | 84171 | CM05CD151K |
| C113 | 100pf | C: Mica 500 volts ±10% | 84171 | CM05ED101K |
| C114 | 1000pf | C: Ceramic 300 volts ±20% | 56289 | C016A102G102M |
| C115 | 150pf | C: Mica 500 volts ±10% | 84171 | CM05ED151K |
| C116 | 3.3pf | C: Ceramic 1000 volts ±0.5pf | 56289 | C030A102E3R3D |
| C117 | 3.3pf | C: Ceramic 1000 volts ±0.5pf | 56289 | C030A102E3R3D |
| C118 | 47pf | C: Mica 500 volts ±10% | 84171 | CM05ED470K |
| C119 | 47pf | C: Mica 500 volts ±10% | 84171 | CM05ED470K |
| C120 | 500pf | C: Ceramic 300 volts ±10% | 56289 | C016A102F501K |
| C121-C123 | | | | |
| C124 | 820pf | C: Mica 300 volts ±5% | 84171 | CM06CC821J |
| C126 | 20pf | C: Mica 500 volts ±10% | 84171 | CM05ED200K |
| C127 | 75pf | C: Mica 500 volts ±10% | 84171 | CM05ED750K |
| C128 | 0.1μf | C: Dip Mylar 50 volts ±40% | 07994 | FM0104U |
| C129 | 0.01μf | C: Ceramic 100 volts ±20% | 56289 | C023A101F103M |
| C130 | 10pf | C: Mica 500 volts ±10% | 84171 | CM05ED100K |
| C131 | 180 pf | C: Mica 500 volts ±5% | 84171 | CM05ED181J |
| C132 | 10pf | C: Mica 500 volts ±10% | 84171 | CM05ED100K |
| CR3 | | Diode: Hot Carrier | 28480 | HP5082-2811 |
| CR4-5 | | Diode: Silicon | 03508 | 1N914A |
| CR6-7 | | Diode: Hot Carrier | 28480 | HP5082-2811 |
| CR8-9 | | Diode: Silicon | 03508 | 1N914A |
| CR10 | | Diode: Hot Carrier | 28480 | HP5082-2811 |
| CR11-CR23 | | Diode: Silicon | 03508 | 1N914A |
| CR27 | | Diode: Silicon | 03508 | 1N914A |
| CR28 | | Diode: Silicon | 03508 | 1N914A |
| CR29-CR30 | | Diode: Silicon Matched Set | 07421 | P00347301 |
| CR31 | | Diode: Silicon | 03508 | 1N645 |
| CR32 | | Diode: Silicon | 03508 | 1N645 |
| CR35-CR38 | | Diode: Silicon | 04713 | 1N4002 |
| CR48-CR58 | | Diode: Silicon | 03508 | 1N914A |
| CR61-CR71 | | Diode: Silicon | 03508 | 1N914A |
| CR72 | | Diode: Silicon | 07263 | FD333 |

## Table 6-2. Parts List (Continued)

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| CR73-CR75 | | Diode: Silicon | 03508 | 1N914A |
| CR76 | | Diode: Silicon | 01295 | 1N4448 |
| DS2 | | Lamp: 28 volts 40ma Red | MURA | L28/40-R |
| F1 | 0.3 Amp | Fuse: SloBlo for 115 volts operation | 75915 | 313.300 |
| F1 | 0.15 Amp | Fuse: SloBlo for 230 volts operation | 75915 | 313.115 |
| IC1-2 | | Integrated Circuit: Dual 741 8-Pin Dip | 18324 | N5558V |
| IC4 | | Integrated Circuit: 3086 14-Pin Dip | 02735 | CA3086 |
| IC5 | | Integrated Circuit: 710 14-Pin Dip | 02195 | SN72710N |
| IC6 | | Integrated Circuit: 3086 14-Pin Dip | 02735 | CA3086 |
| IC7-8 | | Integrated Circuit: 3039 12-Pin T05 | 02735 | CA3039 |
| IC9 | | Integrated Circuit: 3018A 12-Pin T05 | 02735 | CA3018A |
| IC10-IC11 | | Integrated Circuit: 741 8-Pin Dip | 01295 | SN72741P |
| IC13 | | Integrated Circuit: 710 14-Pin Dip | 01295 | SN72710N |
| IC14 | | Integrated Circuit: 7200 14-Pin Dip | 01295 | SN7400N |
| IC15 | | Integrated Circuit: 3030 14-Pin Dip | 02735 | CA3030 |
| IC16 | | Integrated Circuit: 710 14-Pin Dip | 01295 | SN72710N |
| IC17 | | Integrated Circuit: 741 8-Pin Dip | 01295 | SN72741P |
| IC18 | | Integrated Circuit: 741 8-Pin Dip | 01295 | SN72741P |
| L1 | 62μh | Inductor: Fixed | 76493 | 9210-66 |
| L2 | 2.7μh | Inductor: Fixed | 76493 | 9310-22 |
| Q1 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q2-Q3 | | TSTR: Silicon Matched Set | 07421 | P00347099 |
| Q4 | | TSTR: N Channel JFET | 07421 | P00347205 |
| Q5 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q6 | | TSTR: Silicon PNP | 04713 | 2N3906 |
| Q7 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q8 | | TSTR: Silicon PNP | 04713 | 2N3906 |
| Q9 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q10 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q11 | | TSTR: Silicon PNP | 04713 | 2N3906 |
| Q12 | | TSTR: Silicon PNP | 04713 | 2N3906 |
| Q13 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q14 | | TSTR: Silicon PNP | 07421 | 2N3906 |
| Q15 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q16 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q17 | | TSTR: Silicon PNP | 04713 | 2N2905A |
| Q18 | | TSTR: Silicon PNP | 04713 | 2N3251A |
| Q19 | | TSTR: Silicon NPN | 07421 | P00347006 |
| Q20 | | TSTR: Silicon PNP | 04713 | 2N2905A |
| Q21 | | TSTR: Silicon NPN | 04713 | 2N3904 |
| Q23 | | TSTR: Silicon NPN | 01295 | TIP29A |
| Q24 | | TSTR: Silicon NPN | 01295 | 2N2219A |
| Q25 | | TSTR: Silicon NPN | 01295 | 2N3904 |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| Q26 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q27 | | TSTR: Silicon PNP | 01395 | 2N2905A |
| Q28 | | TSTR: Silicon PNP | 01295 | TIP30A |
| Q29 | | TSTR: Silicon PNP | 01295 | 2N2905A |
| Q30 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q31 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q32 | | TSTR: Silicon NPN | 01295 | 2N2219A |
| Q33 | | TSTR: Silicon NPN | 01295 | 2N2219A |
| Q48 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q49 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q50 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q51 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q52 | | TSTR: Silicon PNP | 02735 | 2N5771 |
| Q53 | | TSTR: Silicon PNP | 02735 | 2N5771 |
| Q54 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q55 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q57 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q58 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q59 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q60 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q61 | | TSTR: N Channel Dual FET | 07421 | P00347201 |
| Q62 | | TSTR: Silicon NPN | 01295 | 2N5187 |
| Q63 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| Q64 | | TSTR: Silicon NPN | 07421 | P00347000 |
| Q65 | | TSTR: Silicon PNP | 01295 | 2N3906 |
| Q66 | | TSTR: Silicon NPN | 01295 | 2N3904 |
| R1 | 2.5K | R: Variable 1/4 Watt ±30% | 71590 | TSV-2.5K |
| R2 | 4.99K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4991F |
| R3 | 8.25K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-8251F |
| R4 | 10K | R: Variable 1/4 Watt ±30% | 80740 | BC30848 |
| R5 | 1K | R: Variable 2 Watt | 07421 | P00347675 |
| R6 | 13.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1302F |
| R8-R9 | 15.0K | R: Metal Film 1/2 Watt Matched Set ±25 ppm/°C | 07421 | P00347617-1502 |
| R10-R11 | 15.0K | R: Metal Film 1/2 Watt Matched Set ±25 ppm/°C | 07421 | P00347617-1502 |
| R12 | 2.05K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2051F |
| R13 | 1.30K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1301F |
| R14 | 2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-202J |
| R15-R16 | 1.69K | R: Metal Film 1/2 Watt Matched Set | 07421 | P00347616-1691 |
| R17 | 1Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-105J |
| R18 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R20 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-10N |
| R21 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R22 | 2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-202J |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R24 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R25 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R26 | 18Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-186J |
| R27 | 18Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-186J |
| R28 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R29 | 2.5K | R: Variable 1/4 Watt ±30% | 71590 | TSV-2.5K |
| R30 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R31 | 200 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-201J |
| R32 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R33 | 2.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-222J |
| R34 | 3.3K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-332J |
| R35 | 3.3K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-332J |
| R36 | 1.1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-112J |
| R37 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |
| R38 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |
| R39 | 620 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-621J |
| R40 | 680 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-681J |
| R42 | 1.3K | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-132J |
| R43 | 220 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-221J |
| R44 | 68 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-680J |
| R45 | 750K | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-754J |
| R46 | 1.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1501F |
| R47 | 3.01K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3011F |
| R48 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R49 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R50 | 976 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-9760F |
| R51 | 100 | R: Variable 1/4 Watt ±30% | 71590 | TSV-100 |
| R52 | 6.19K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-6191F |
| R53 | 5.76K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-5761F |
| R54 | 1K | R: Variable 1/4 Watt ±30% | 71590 | TSV-1K |
| R55 | 2.37K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2371F |
| R56 | 1.82K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1821F |
| R57 | 1.3K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG20-132J |
| R58 | 301 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3010F |
| R59 | 2.32K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2321F |
| R60 | 3.01K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3011F |
| R61 | 3.74K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3741F |
| R62 | 3.57K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3571F |
| R63 | 500 | R: Variable 1/4 Watt ±30% | 71590 | TSV-500 |
| R64 | 7.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7501F |
| R65 | 7.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7501F |
| R66 | 1.30K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1301F |
| R67 | 250 | R: Variable 1/4 Watt ±30% | 71590 | TSV-250 |
| R68 | 200 | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-201J |
| R69 | 200 | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-201J |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R70 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R71 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R72 | 39 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-390J |
| R74 | | R: Network ±1% | 07421 | PR0347404 |
| R76 | 13.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1302F |
| R77 | 500 | R: Variable 1/4 Watt ±30% | 71590 | TSV-500 |
| R78 | 1.47K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1471F |
| R79 | 20K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-203J |
| R80 | 47 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-470J |
| R81 | 1K | R: Variable 1/4 Watt ±30% | 71590 | TSV-1K |
| R82 | 3.09K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3091F |
| R83 | 3.09K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3091F |
| R84 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |
| R85 | 1.2K | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-122J |
| R86 | 47 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-470J |
| R87 | 20K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-203J |
| R88 | 13.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1302F |
| R89 | 500 | R: Variable 1/4 Watt ±30% | 71590 | TSV-500 |
| R90 | 1.47K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1471F |
| R91 | 2.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2001F |
| R92 | 2.49K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2491F |
| R93 | 47K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-473J |
| R94 | 1.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-122J |
| R95 | 150K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-154J |
| R96 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R97 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R98 | 1K | R: Variable 1/4 Watt ±30% | 71590 | TSV-1K |
| R99 | 100 | R: Variable 1/4 Watt ±30% | 71590 | TSV-100 |
| R100 | R: | R: Network ±1% | 07421 | PR0347401 |
| R101 | | R: Network ±1% | 07421 | PR0347401 |
| R102 | 100 | R: Variable 1/4 Watt ±30% | 71590 | TSV-100 |
| R103 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R104 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R105 | 680 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-681J |
| R106 | 68 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-680J |
| R107 | 1K | R: Variable 2 Watts 10% Part of S5 Assy | | |
| R108 | 2.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2001F |
| R109 | 2.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2001F |
| R110 | 2.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2001F |
| R111 | 33 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-330J |
| R112 | 68K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-683J |
| R113 | 31.6 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-31R6F |
| R114 | 3.32K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3321F |
| R115 | 31.6 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-31R6F |
| R116 | 68K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-683J |
| R117 | 1.8K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-182J |

## Table 6-2. Parts List (Continued)

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R118 | 150K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-154J |
| R119 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R120 | 200 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2000F |
| R121 | 22 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-220J |
| R122 | 22 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-220J |
| R123 | 383 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3830F |
| R124 | 62 | R: Carbon 2 Watts ±5% | 75042 | RC42-620J |
| R125 | 7.5 | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-7R5J |
| R126 | 7.5 | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-7R5J |
| R127 | 62 | R: Carbon 2 Watts ±5% | 75042 | RC42-620J |
| R128 | 24.9 | R: Metal Film 1 Watt ±1% | 01295 | MC66D-24R9F |
| R129 | 24.9 | R: Metal Film 1 Watt ±1% | 01295 | MC66D-24R9F |
| R130 | 464 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4640F |
| R131 | 51.1 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-51R1F |
| R132 | 6.98K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-6981F |
| R133 | 10K | R: Variable 2 Watts ±10% Part of S4 Assy | | |
| R134 | 9.31K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-9311F |
| R135 | 3.9K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-392J |
| R137 | 2.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-272J |
| R138 | 15K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-153J |
| R139 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R140 | 2.7 | R: Carbon 1/2 Watt ±5% | 75042 | RC20GF2R7J |
| R141 | 470 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-471J |
| R142 | 5.6K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-562J |
| R143 | 1.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-122J |
| R144 | 15.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1502F |
| R145 | 2.5K | R: Variable 1/4 Watt ±30% | 71590 | TSV-2.5K |
| R146 | 10.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1002F |
| R147 | 4.99K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4991F |
| R148 | 3.01K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3011F |
| R149 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R150 | 220 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-221J |
| R151 | 100 | R: Carbon 1 Watt ±5% | 75042 | RC32GF101J |
| R152 | 470 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-471J |
| R153 | 2.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-272J |
| R154 | 15K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-153J |
| R155 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R156 | 2.7 | R: Carbon 1/2 Watt ±5% | 75042 | RC20GF2R7J |
| R157 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R158 | 15.0K | R: Metal Film 1/2 Watt ±0.25% | 07421 | P00347617-1502 |
| R159 | 15.0K | R: Metal Film 1/2 Watt ±0.25% | 07421 | P00347617-1502 |
| R160 | 4.99K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4991F |
| R161 | 3.01K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3011F |
| R162 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R163 | 220 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-221J |
| R164 | 100 | R: Carbon 1 Watt ±5% | 75042 | RC32GF101J |

## Table 6-2. Parts List (Continued)

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R165 | 220 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-221J |
| R166 | 1K | R: Variable 1/4 Watt ±30% | 71590 | TSV-1K |
| R190 | 2.5K | R: Variable 1/4 Watt ±30% | 71590 | TSV-2.5K |
| R191 | 68 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-680J |
| R192 | 2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-202J |
| R193 | 73.2K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7322F |
| R194 | 86.6K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-8662F |
| R195 | 97.6K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-9762F |
| R196 | 66.5K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-6652F |
| R197 | 10.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1002F |
| R198 | 12.4K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1242F |
| R199 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R200 | 2.05K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2051F |
| R201 | 1.30K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1301F |
| R202 | 6.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-622J |
| R203 | 500 | R: Variable 1/4 Watt ±30% | 71590 | TSV-500 |
| R204 | 3.32K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3321F |
| R205 | 15Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-156J |
| R206 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R207 | 26.1K | R: Metal Film 1/2 Watt ±1% ±25 ppm/$^{o}$C | 01295 | MC60E-2612F |
| R208 | 10.0K | R: Metal Film 1/2 Watt ±1% ±25 ppm/$^{o}$C | 01295 | MC60E-1002F |
| R209 | 16.5K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1652F |
| R210 | 1K | R: Variable 2 Watt | 07421 | P00347678-1 |
| R213 | 1Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-105J |
| R214 | 5.1K | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-512J |
| R215 | 27K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-273J |
| R216 | 1.1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-112J |
| R217 | 8.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-822J |
| R218 | 3.9K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-392J |
| R219 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R220 | 3K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-302J |
| R222 | 1.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-122J |
| R223 | 910 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-911J |
| R224 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R225 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R226 | 470 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-471J |
| R227 | 2.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-222J |
| R228 | 10K | R: Variable 1/4 Watt ±30% | 71590 | TSV-10K |
| R229 | 1.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-122J |
| R230 | 130 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-131J |
| R233 | 39 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-390J |
| R234 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R235 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R236 | 7.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7501F |
| R237 | 7.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7501F |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R238 | 3.32K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3321F |
| R239 | 1.18K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1181F |
| R240 | 1.3K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1301F |
| R241 | 3.32K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3321F |
| R242 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R243 | 1.21K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1211F |
| R244 | 4.99K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4991F |
| R245 | 43K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-433J |
| R246 | 7.87K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-7871F |
| R247 | 10 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-100J |
| R248 | 10K | R: Variable 2 Watts Part of S3 Assy | | |
| R256 | 95.3 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-95R3F |
| R257 | 71.5 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-71R5F |
| R258 | 97.6 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-97R6F |
| R259 | 40.2 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-40R2F |
| R260 | 10.0 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-10R0F |
| R261 | 41.2 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-41R2F |
| R262 | 71.5 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-71R5F |
| R263 | 158 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1580F |
| R264 | 10.7 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-10R7F |
| R265 | 39.2 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-39R2F |
| R268 | 18K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-183J |
| R269 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R270 | 10k | R: Variable 2 Watts Part of S6 Assy | | |
| R271 | 30k | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-303J |
| R272 | 10k | R: Metal Glaze 1 Watt ±5% | 75042 | RG32-103J |
| R273 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R274 | 82K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-823J |
| R275 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R276 | 1.8K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-182J |
| R277 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R278 | 1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-102J |
| R279 | 1.5K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-152J |
| R280 | 2.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-222J |
| R281 | 2.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-222J |
| R282 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R286 | 43 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-430J |
| R287 | 5K | R: Variable 2 Watts Part of S7 Assy | | |
| R288 | 2.5K | R: Variable 1/4 Watt ±30% | 71590 | TSV-2.5K |
| R289 | 42.2K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4222F |
| R290 | 422K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4223F |
| R291 | 4.22Meg | R: Metal Film 1/2 Watt ±1% | 01295 | CD1/2MR-4224F |
| R292 | 12.1K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1212F |
| R293 | 1.33K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1331F |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R294 | 133K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1333F |
| R295 | 30.1K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3012F |
| R296 | 30.1K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3012F |
| R297 | 10.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1002F |
| R298 | 10.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1002F |
| R299 | 39K | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG1/4-393J |
| R300 | 1.8Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | RBT1/4-185J |
| R301 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R302 | 1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-102J |
| R303 | 1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-102J |
| R304 | 1.8K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-182J |
| R305 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |
| R306 | 560 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-561J |
| R307 | 1K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-102J |
| R308 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |
| R309 | 100 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-101J |
| R310 | 390 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-391J |
| R311 | 1.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1001F |
| R312 | 1.5K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-152J |
| R313 | 1.69K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1691F |
| R314 | 6.8K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-682J |
| R315 | 1.5K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-152J |
| R316 | 2.00K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-2001F |
| R317 | 68K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-683J |
| R318 | 1Meg | R: Metal Glaze 1/4 Watt ±5% | 75042 | GBT1/4-105J |
| R319 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R320 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R321 | 2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-202J |
| R322 | 3.3K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-332J |
| R323 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R324 | 47K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-473J |
| R325 | 2.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-222J |
| R326 | 6.8K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-682J |
| R327 | 4.7K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-472J |
| R328 | 36K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-363J |
| R329 | 10K | R: Variable 1/4 Watt ±30% | 71590 | TSV-10K |
| R330 | 33.2K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3322F |
| R331 | 13.3K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1332F |
| R332 | 11.0K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1102F |
| R333 | 604 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-6040F |
| R334 | 6.2K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-622J |
| R340 | 10K | R: Variable 2 Watts Part of S5 Assy | | |
| R341 | 1.18K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1181F |
| R342 | 470 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-471J |
| R343 | 3.6K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-362J |
| R344 | 51 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-510J |

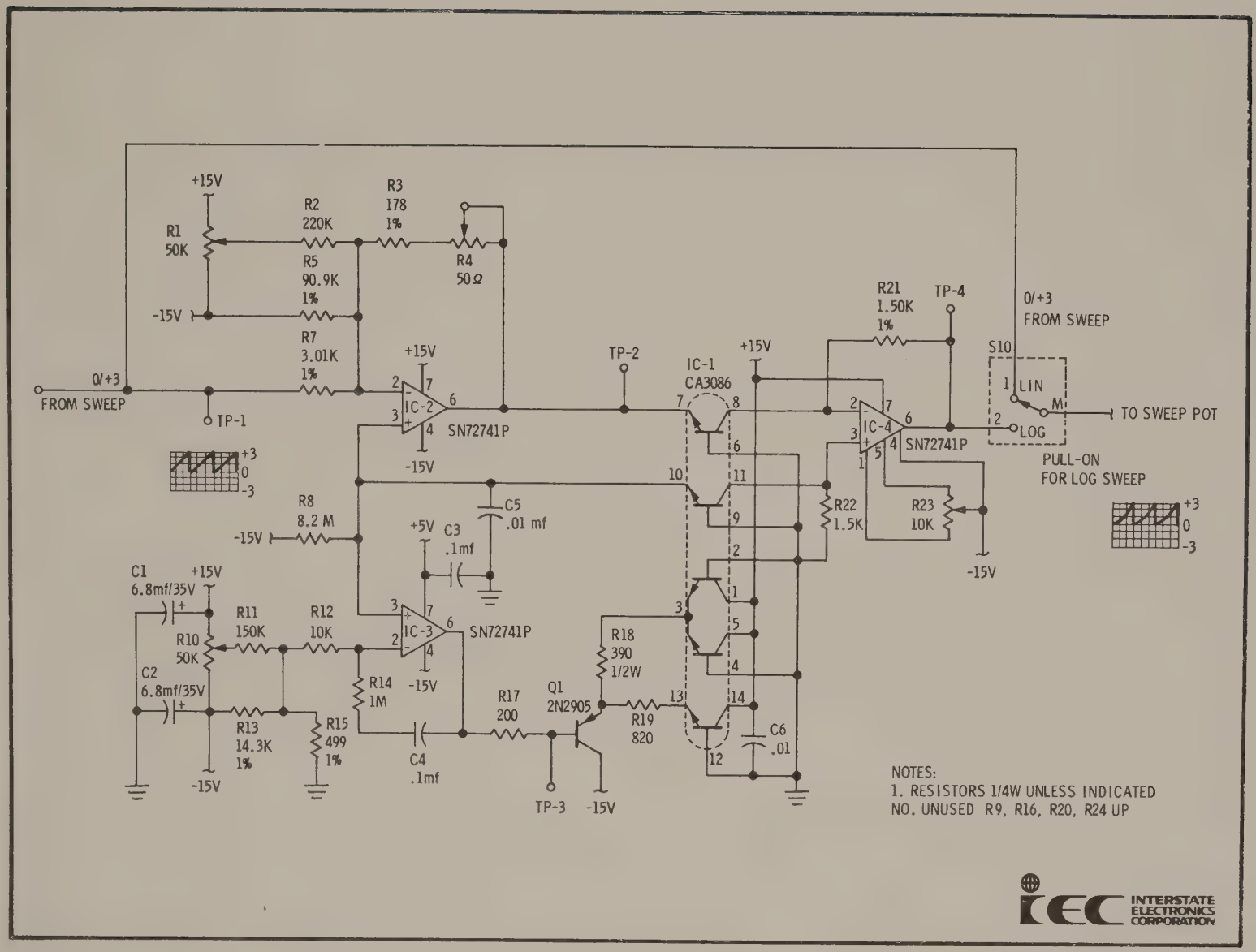
**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| S1 | | Switch: Slide W/Ind DS1 Power | 22753 | LRSW322-1-28V-W |
| S2 | | Switch: Rotary Multiplier | 07421 | PR0347904 |
| S3 | | Switch: Rotary F31, Only Waveform | 07421 | PR0347902-1 |
| S3 | | Switch: Rotary W/R248 Waveform | 07421 | PR0347902-2 |
| S4 | | Switch: Pull W/R133 Offset | 07421 | PR0347910 |
| S5 | | Switch: Pull W/R107 F31 Only Attenuator | 07421 | PR0347909 |
| S5 | | Switch: Rotary W/R107 Attenuator | 07421 | PR0347908 |
| S6 | | Switch: Rotary W/R270 Mode | 07421 | PR0347906 |
| S7 | | Switch: Rotary W/R287 Sweep Time | 07421 | PR0347907 |
| S8 | | Switch: Slide Power Selector | 82389 | 46256LF |
| S9 | | Switch: Pushbutton Manual Trigger | 82389 | 963 |
| T1 | | Transformer: Power | 07421 | PR0347800 |
| VR1 | 5.1V | Diode: Zener 400 mw ±5% | 04713 | 1N5231B |
| VR2 | 12V | Diode: Zener 400 mw ±5% | 04713 | 1N5242B |
| VR3 | 6.8V | Diode: Zener 400 mw ±5% | 04713 | 1N5235B |
| VR4 | 5.1V | Diode: Zener 400 mw ±5% | 04713 | 1N5231B |
| VR5 | 12V | Diode: Zener 400 mw ±5% | 04713 | 1N5242B |
| VR6 | 6.8V | Diode: Zener 400 mw ±5% | 04713 | 1N5235B |
| VR7 | 6.8V | Diode: Zener 400 mw ±5% | 04713 | 1N5235B |
| | | Knob: Frequency F31, F32, F33 | 07421 | P00333100-4 |
| | | Knob: Frequency F34 | 07421 | P00333100-5 |
| | | Knob: Frequency Vernier | 07421 | PR0335022-3 |
| | | Knob: Pointer | 07421 | PR0335022-2 |
| | | Knob: Pointer Concentric Set | 07421 | PR0335022-1 |
| | | Heat Sink: Large TO-5 | 13103 | TXBF2227C |
| | | Heat Sink: Medium TO-5 | 13103 | TXBF2226C |
| | | Heat Sink: Small TO-18 | 13103 | TXBF2224C |
| | | A3 Card F-37 | | |
| C1 | 6.8mf | C: Tant Electrolytic 35V ±10% | 56289 | 196D685X0035KA1 |
| C2 | 6.8mf | C: Tant Electrolytic 35V ±10% | 56289 | 196D685X0035KA1 |
| C3 | 0.1mf | C: Dip Mylar 50V ±40% | 07994 | FM0104U |
| C4 | 0.1mf | C: Dip Mylar 50V ±40% | 07994 | FM0104U |
| C5 | 0.01mf | C: Ceramic 100V ±20% | 56289 | C023A101F103M |
| C6 | 0.01mf | C: Ceramic 100V ±20% | 56289 | C023A101F103M |
| IC1 | | Integrated Circuit: 14 Pin DIP | 02735 | CA3086 |
| IC2 | | Integrated Circuit: 8 Pin DIP | 01295 | SN72741P |
| IC3 | | Integrated Circuit: 8 Pin DIP | 02195 | SN72741P |
| IC4 | | Integrated Circuit: 8 Pin DIP | 02195 | SN72741P |
| Q1 | | TSTR: Silicon PNP | 04713 | 2N2905A |

**Table 6-2. Parts List (Continued)**

| REF DESIG | VALUE | DESCRIPTION | MFG CODE | PART NUMBER |
|---|---|---|---|---|
| R1 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R2 | 220K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-224J |
| R3 | 178 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1780F |
| R4 | 50 | R: Variable Cermet 1/4 Watt | Beckman | 91V-50 |
| R5 | 90.9K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-9092F |
| R7 | 3.01K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-3011F |
| R8 | 8.2M | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-825J |
| R10 | 50K | R: Variable 1/4 Watt ±30% | 71590 | TSV-50K |
| R11 | 150K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-154J |
| R12 | 10K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-103J |
| R13 | 14.3K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1432F |
| R14 | 1M | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-105J |
| R15 | 499 | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-4990F |
| R17 | 200 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-201J |
| R18 | 390 | R: Metal Glaze 1/2 Watt ±5% | 75042 | RG20-391J |
| R19 | 820 | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-821J |
| R21 | 1.50K | R: Metal Film 1/2 Watt ±1% | 01295 | MC60D-1501F |
| R22 | 1.5K | R: Metal Glaze 1/4 Watt ±5% | 75042 | RG1/4-152J |
| R23 | 10K | R: Variable 1/4 Watt ±30% | 71590 | TSV-10K |
| S10 | | Switch: Push-Pull (Part of S7, Swp Time) | 07421 | P00347935-1 |

NOTES




Log Sweep Schematic Diagram (F37)

# F30

# Supplement

The Model F30 Function Generator consists of a basic waveform generator, a single-range sweep circuit, and a sweep marker generator.

## OPERATION

The sweep mode is initiated by turning the SWEEP WIDTH control clockwise. The frequency of the output waveform then begins from a point set on the main frequency dial and sweeps upward in frequency to an end point adjusted by rotating the SWEEP WIDTH control. The repetition rate of the sweep is set by the SWEEP RATE control. The sweep ramp may be observed at the SWEEP OUT BNC connector.

The sweep marker generator consists of a rectangular waveform whose width may be varied by the SWEEP MARKER control to coincide with any desired point of the sweep ramp. In use, the main output of the generator is observed on one trace of a dual-trace oscilloscope, while the MARKER output is connected to the other scope channel. The marker waveform may then be adjusted to coincide with any point of interest on the swept waveform display. When the MARKER CAL pushbutton switch is depressed, the main output stops sweeping and holds at the frequency indicated by the marker. In this way, the frequencies of the start and stop points may be accurately determined as well as the frequency of any selected point between.

## CALIBRATION PROCEDURE

The following procedures should be accomplished after completing procedures applicable to Model F31 in the front section of this manual:

### 1.0 FREQUENCY ANALOG

1.1 Set the frequency dial to low stop (full clockwise).

- Connect DVM-DC to GCV BNC.
- Adjust R329 for 0.000 Vdc ±0.002V.

1.2 Set frequency dial to 3.0.

- Check output for 5.0 Vdc ±0.5V.

### 2.0 SWEEP

2.1 Connect scope to SWEEP OUT BNC.

- Set SWEEP RATE maximum counterclockwise.
- Set SWEEP WIDTH clockwise.
- Adjust R301 for repetition time of 20 sec + 1 sec − 0 sec.

2.2 Set SWEEP RATE maximum clockwise.

- Adjust R288 for repetition time of 30 msec − 2 msec + 0 msec.

## 2.0 SWEEP (Continued)

2.3 Connect scope to OUTPUT BNC (terminiated in 50 ohms).

- Set Frequency dial at low stop (full clockwise).
- Set FREQ multiplier at 100K.
- Set SWEEP RANGE control in midposition.
- Set SWEEP WIDTH control as far counterclockwise as possible with switch on.
- Adjust R203 to null frequency modulating.

## 3.0 MARKER

3.1 Connect dual-trace scope to SWEEP OUT and MKR BNCs.

- Set SWEEP MARKER full counterclockwise.
- Observe transistor-transistor logic (TTL) negative-going pulse. Transition at beginning of sweep ramp to be 5 percent or less of sweep ramp time.

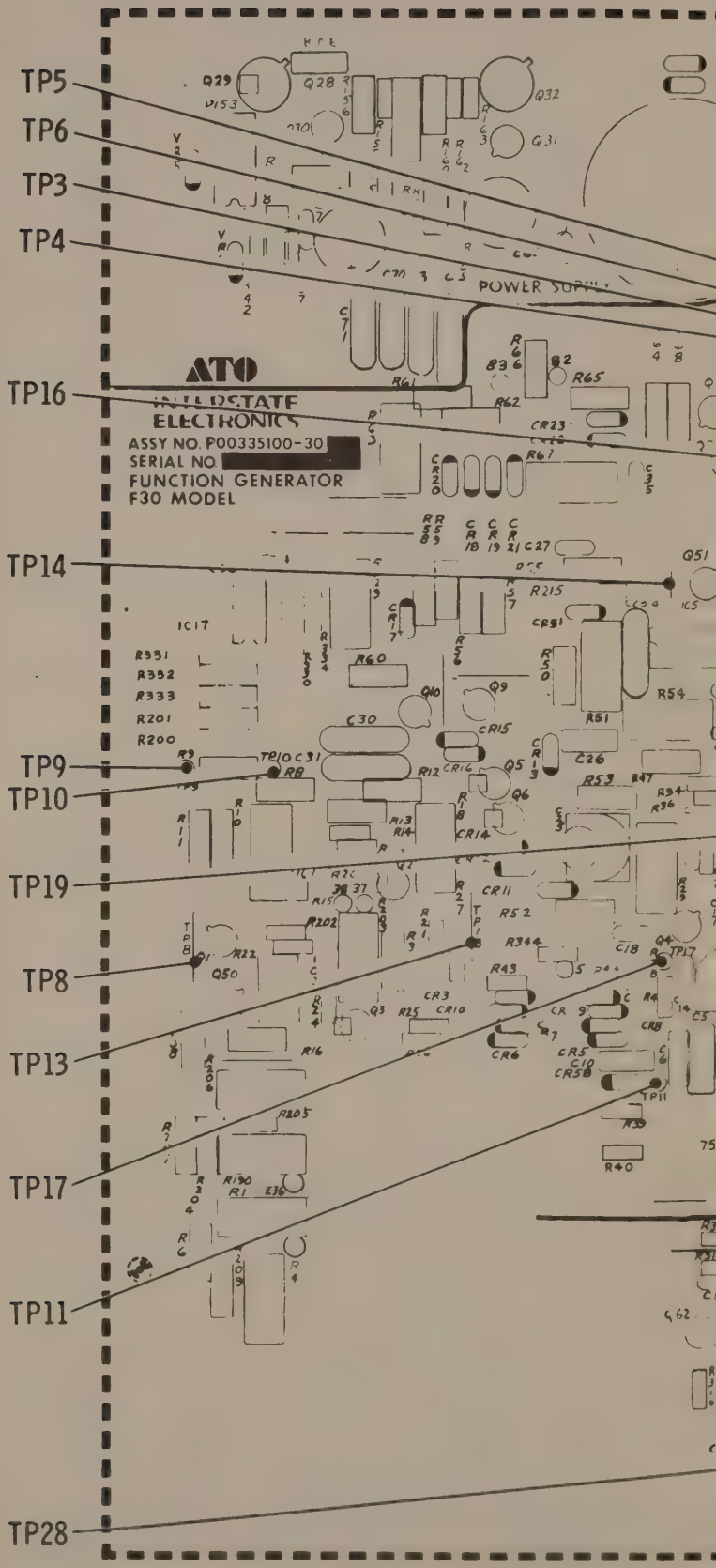
3.2 Set SWEEP MARKER full clockwise.

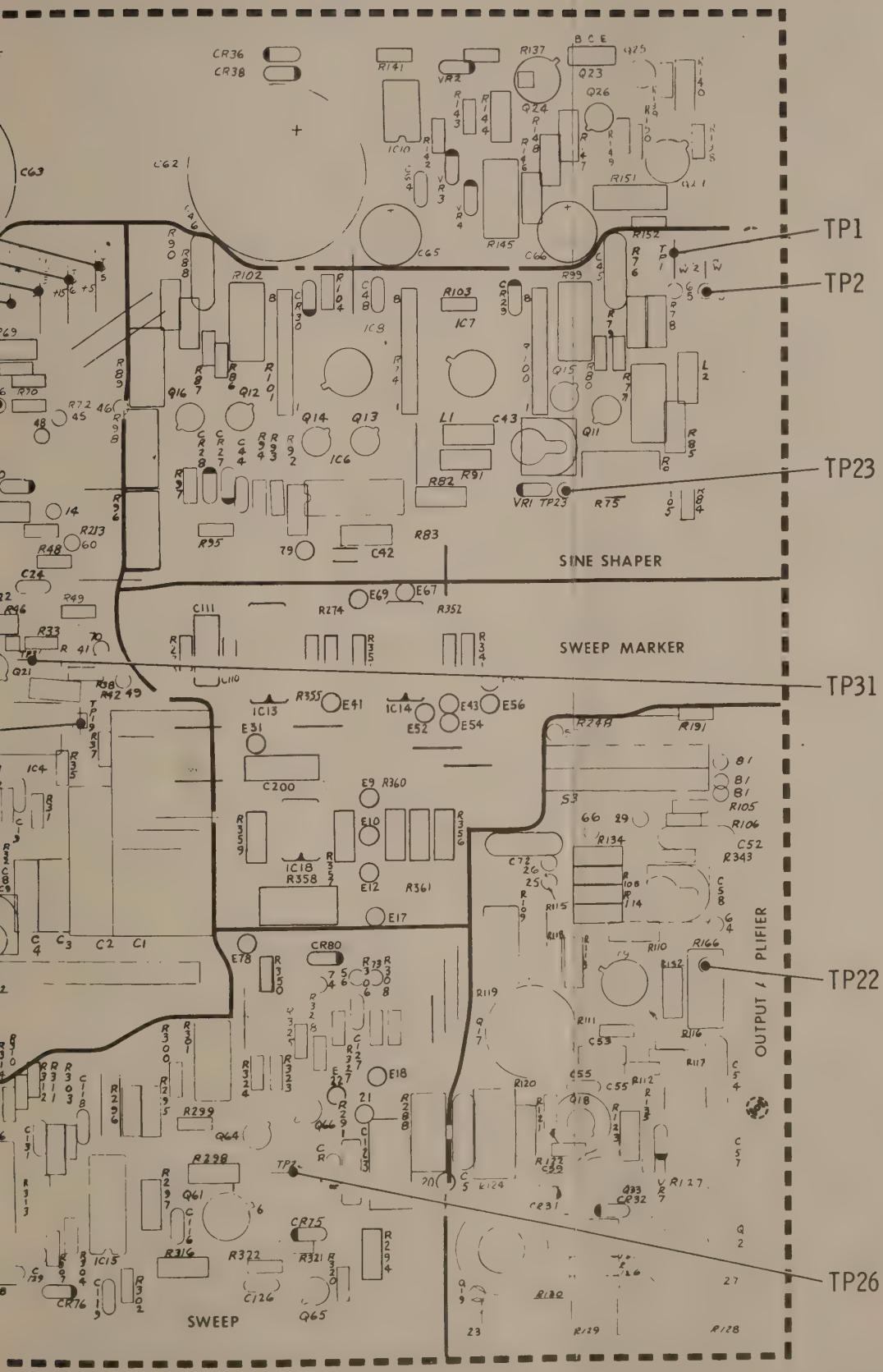
- Adjust R358 until marker pulse just disappears.

# ADDITIONS TO PARTS LIST

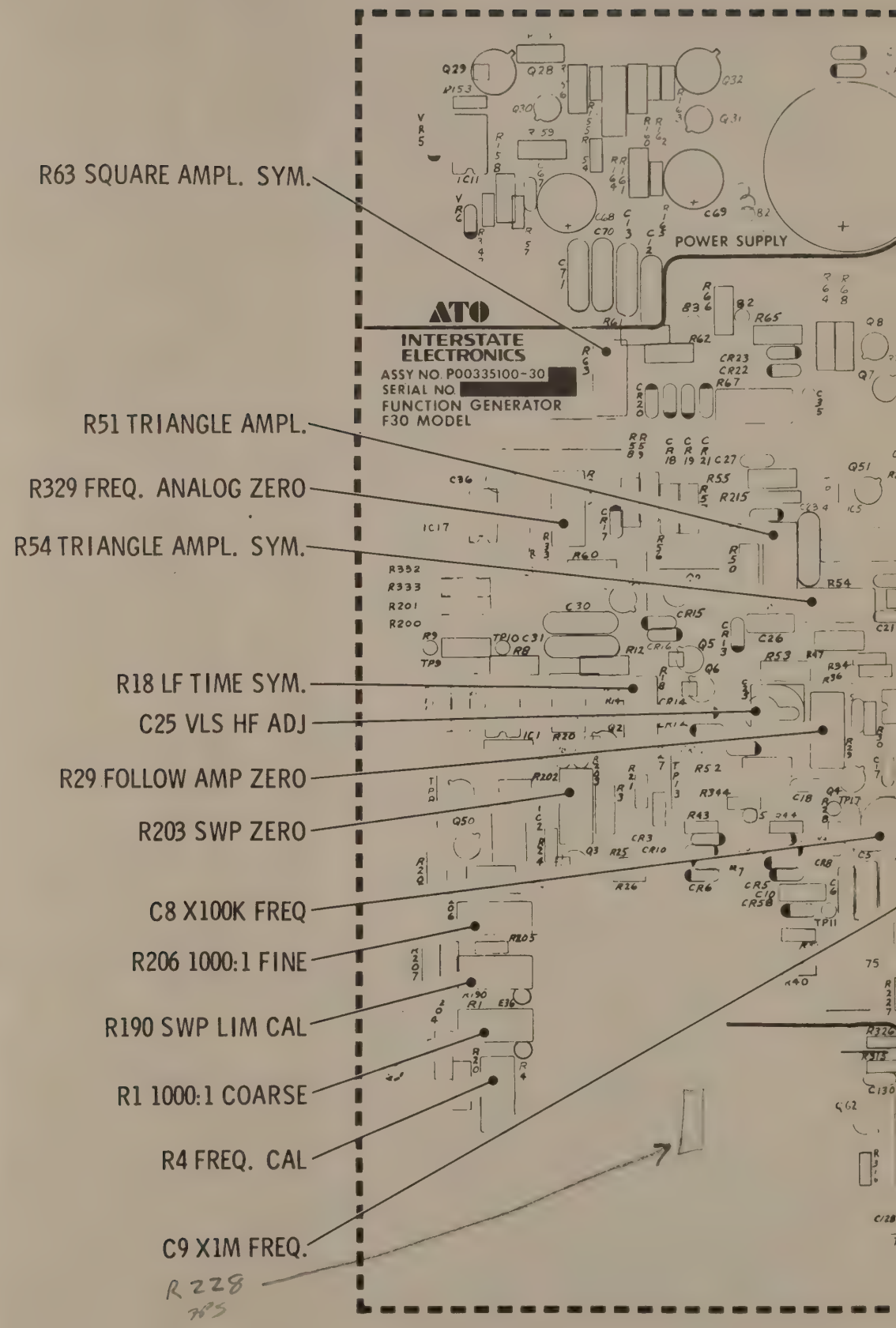
Except for the following references, parts identifications for Model F30 are listed in the front section of this manual.

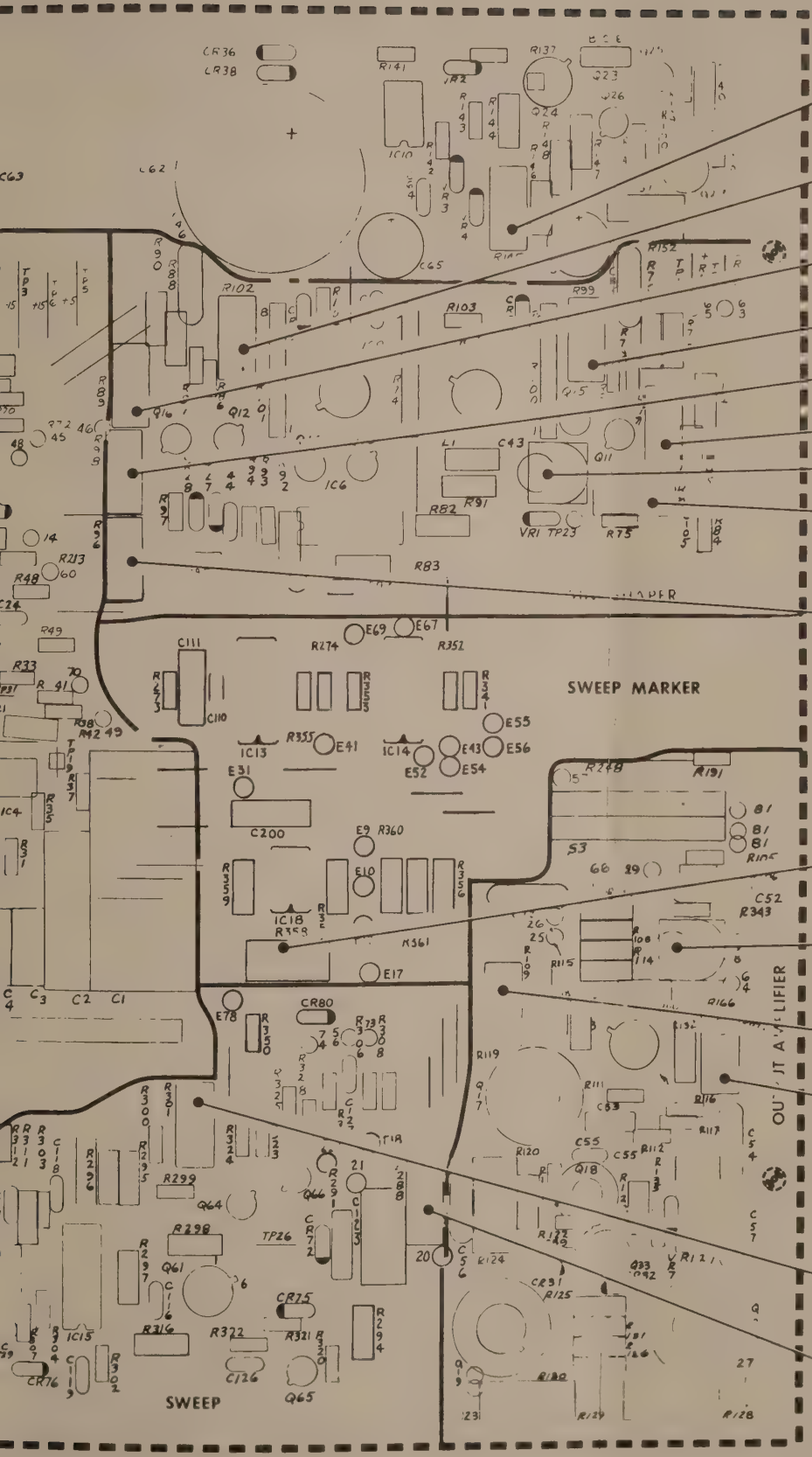
| Reference Designator | Value | Description | Manufacturer |
|---|---|---|---|
| C123 | 0.27 $\mu$F | 100V, 10%, Metal Mylar | CD |
| R44 | 120 | 1/4W, 5%, Metal Glaze | |
| R130 | 464 | 1/2W, 1%, Metal Film | |
| R131 | 51.1 | 1/2W, 1%, Metal Film | |
| R209 | 8.25K | 1/2W, 1%, Metal Film | |
| R210 | 1K | See S20 | |
| R287 | 5K | See S20 | |
| R291 | 422K | 1/2W, 1%, Metal Film | |
| R350 | 20 | 1/4W, 5%, Metal Glaze | |
| R352 | 10 | 1/4W, 5%, Metal Glaze | |
| R353 | 220 | 1/4W, 5%, Metal Glaze | |
| R354 | 10K | P00347677 Potentiometer | IEC |
| R355 | 2.2K | 1/4W, 5%, Metal Glaze | |
| R356 | 10 | 1/4W, 5%, Metal Glaze | |
| R357 | 3.32K | 1/2W, 1%, Metal Film | |
| R358 | 2.5K | TSV-2.5K, 1/4W, 30%, Trimpot | CRL |
| R359 | 9.09K | 1/2W, 1%, Metal Film | |
| R360 | 8.06K | 1/2W, 1%, Metal Film | |
| R361 | 448 | 1/2W, 1%, Metal Film | |
| S20 | – | P00347945 Assembly with R210 and R287 | IEC |
| S21 | | 963 Pushbutton Switch | Switchcraft |


TP5
TP6
TP3
TP4
TP16
TP14
TP9
TP10
TP19
TP8
TP13
TP17
TP11
TP28
ATO
ELECTRONICS
ASSY NO. P00335100-30
SERIAL NO.
FUNCTION GENERATOR
F30 MODEL
POWER SUPPLY




F30 Test Point Location Diagram


R63 SQUARE AMPL. SYM.
R51 TRIANGLE AMPL.
R329 FREQ. ANALOG ZERO
R54 TRIANGLE AMPL. SYM.
R18 LF TIME SYM.
C25 VLS HF ADJ
R29 FOLLOW AMP ZERO
R203 SWP ZERO
C8 X100K FREQ
R206 1000:1 FINE
R190 SWP LIM CAL
R1 1000:1 COARSE
R4 FREQ. CAL
C9 X1M FREQ.
R228
ATO
INTERSTATE ELECTRONICS
ASSY NO. P00335100-30
SERIAL NO.
FUNCTION GENERATOR
F30 MODEL
POWER SUPPLY




F30 Adjustment Location Diagram

WAVEFORM TEST CONDITIONS: UNLESS OTHERWISE SPECIFIED.

| | |
|---|---|
| FREQ MULT | @ 10K |
| FREQ DIAL | @ 3.0 |
| WAVEFORM | @ SINE |
| OFFSET | OFF |
| AMPLITUDE | @ 10V (IN FOR P31) |
| OUTPUT | @ CW STOP |
| VOLTAGES | @ TP1: +12.2 ± 3.2 VDC |
| | TP2: -22.1 ± 3.2 VDC |
| | TP5: +15 ± 0.1 VDC |

T/C 1. +10.0 VCG INPUT...WITH FREQ DIAL @ CW STOP

T/C 2. WAVEFORM @ VAR PULSE, VAR PULSE CENTERED.

T/C 3. MODE @ TRIG, TRIG LEVEL - CENTERED; TRIG/SYNC INPUT 2.8 PP; ~SINE @ 10K±2. SYNC SCOPE TO EXTERNAL INPUT.

T/C 4. MODE @ GATE, TRIG LEVEL - CENTERED; TRIG/SYNC INPUT 2V PP; SINE @ 10K±2.

T/C 5. MODE @ CONT SWP, WAVEFORM @ SWP; SWP TIME @ 1 MS; SWP VERNIER @ CAL.

T/C 6. MODE @ CONT SWP; WAVEFORM @ SINE; SWP TIME @ 1 MS; SWP VERNIER @ CAL, SWP LIMIT @ MAX.

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL PNP TRANSISTORS ARE P003947102 (2N3906).
2. ALL NPN TRANSISTORS ARE P003947001 (2N3904).
3. ALL RESISTORS ARE ±5%, 1/4W.
4. ALL 1% RESISTORS ARE 1/2W.
5. ALL DIODES ARE 1N914.
6. ALL CAPACITORS IN DECIMALS (0.01) ARE IN μf.
7. ALL CAPACITORS NOT IN DECIMALS ARE IN pf.

(A) INDICATED RESISTORS ARE MATCHED TO WITHIN 4Ω.
(B) INDICATED RESISTORS ARE MATCHED TO WITHIN 30Ω.
(C) INDICATED RESISTORS ARE MATCHED TO WITHIN 30Ω.
(D) INDICATED TRANSISTORS MATCHED PER P003947038 P
(E) INDICATED COMPONENTS ARE SELECTED IN TEST.

| REF DESIG | APPROX VALUE |
|---|---|
| C6 | 0 |
| C10 | 47 |
| C35 | 10 |
| C125 | 0 |
| C131 | 200 |

M. RESISTORS NOTED IN (B), (C) OR (D) ARE MATCHED PER P003947646.
(B) INDICATED CAPACITORS MATCHED PER P003947358.
(C) INDICATED CAPACITORS MATCHED PER P003947781.
(D) INDICATED DIODES MATCHED PER P003947301.
(E) INDICATED RESISTORS MATCHED WITHIN 30Ω.

CURRENT CONTROL

INTEGRATOR

FOLLOW AMP

OFFSET

OUTPUT AMPLIFIER

WAVEFORM SWITCH S3

FREQ. ANALOG

VOLTAGE LEVEL SENSOR

FREQ CONTROL

SINE SHAPER

POWER SUPPLY

SWEEP MARKER

+15V R360 8.06K ±1% R361 998 ±1% R358 2.5K R357 69.332K ±1% R359 9.09K ±1% SWEEP MARKER CW CCW R354 10K E10 E12 R356 10 IC18 7741 -15V C200 .1 E31 R355 2.2K

+15V R273 390 C111 .1 VOL LEVEL SENSOR R43 220 R44 12 E5 E8 E69 E67 +5V R353 220 IC14 SN7400 IC19 SN7400 R352 10 E43 E54 J3 SYNC OUT

R274 47K IC17 MA710 C110 .01 -5V IC19 SN7400 R341 10 E55 E87 J2 MKR

E16 NC NO MKR CAL S21 963 E18 R306 560 E73 E74 J5 SWEEP OUT

R308 51

FREQ CONTROL R204 R190 E36 E37

FRONT PNL SWEEP WIDTH R210 1K CW CCW CCW OFF +5V E88 ON CW S20 E78 E56 R350 20

SWEEP RATE R287 5K CW CCW E22 E20 E21 R291 422K ±1% R294 12.1K ±1% E15 TP26 CR72 FD333 HI RATE CAL R288 1K -15V

+15V Q61 P00347201 R299 39K R300 1.8M LO CAL R301 50K R302 1K C119 47 C116 3.3 R297 10K ±1% R298 10K ±1% -15V +15V CA3030 IC15 R295 30.1K ±1% R296 30.1K ±1% R303 1K C118 47 TP28 R304 1.8K -15V

+15V R310 390 R316 2K ±1%

T/C 5 2V/CM .2MS/CM +5V Q65 C123 +27 -15V Q64 P00347000 R321 2K R322 3.3K C126 20 CR75 R320 4.7K -5V +15V R325 2.2K R323 4.7K R224 47K R326 6.8K Q66 -15V R328 36K R327 4.7K C127 75 CR80 E74 CR76 IN4448 R307 1K R313 1.63K ±1% R312 1.5K C131 180 R311 1K ±1% IC16 MA710 C128 .1 C129 .01 -5V R314 6.8K R315 1.5K C130 10 Q62 2N2369A

R130 464 ±1% E23 E27 NC NO PART OF R107 J1 OUTPUT R131 511 ±1% 5S/R107 AMPLITUDE P00347909

SWEEP

DWG TITLE: F30 FUNCTION GENERATOR SCHEMATIC

| IEC DWG NO. (REF) | REV | FIG. NO. | PAGE NO. |
|---|---|---|---|
| P00335001-30 | A | | |

WAVEFORM TEST CONDITIONS: UNLESS OTHERWISE SPECIFIED.

FREQ MULT @ 10K
FREQ DIAL @ 3.0
WAVEFORM @ SINE
OFFSET @ OFF
AMPLITUDE @ 10V (IN FOR P3)
OUTPUT @ CW STOP

VOLTAGES @ TP1: +22.2 ± 3.2 VDC
TP2: -22.1 ± 3.2 VDC
TP3: +15 ± 0.1 VDC

T/C 1: +10.0 VCG INPUT WITH FREQ DIAL @ CW STOP

T/C 2: WAVEFORM @ VAR PULSE, VAR PULSE CENTERED.

T/C 3: MODE @ TP16; TRIG LEVEL -CENTERED; TP14/SYNC INPUT 20 PP; —SINE @ 10KHZ. SYNC SCOPE TO EXTERNAL INPUT.

T/C 4: MODE @ GATE; TP16 LEVEL -CENTERED; TP14/SYNC INPUT 2V PP; SINE @ 10KHZ.

T/C 5: MODE @ CONT SWP; WAVEFORM @ SWP; SWP TIME @ 1MS; SWP VERNIER @ CAL.

T/C 6: MODE @ CONT SWP; WAVEFORM @ SINE; SWP TIME @ 1 MS; —SWP VERNIER @ CAL.; SWP LIMIT @ MAX.

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL PNP TRANSISTORS ARE P00347102 (2N3906).
2. ALL NPN TRANSISTORS ARE P00347001 (2N3904).
3. ALL RESISTORS ARE ±5%, 1/4 W.
4. ALL 1% RESISTORS ARE 1/2 W.
5. ALL DIODES ARE IN916A.
6. ALL CAPACITORS IN DECIMALS (0.01) ARE IN μF.
7. ALL CAPACITORS NOT IN DECIMALS ARE IN pF.

(A) INDICATED RESISTORS ARE MATCHED TO WITHIN 4 Ω.
(B) INDICATED RESISTORS ARE MATCHED TO WITHIN 30 Ω.
(C) INDICATED RESISTORS ARE MATCHED TO WITHIN 30 Ω.
(D) INDICATED TRANSISTORS MATCHED PER P00347038 F
(E) INDICATED COMPONENTS ARE SELECTED IN TEST.

| REF DESIG | APPROX VALUE |
|---|---|
| C6 | 0 |
| C10 | 47 |
| C35 | 10 |
| C123 | 0 |
| C131 | 200 |

16. RESISTORS NOTED IN (B, B & 10 ARE MATCHED PER P00347616.
(B) INDICATED CAPACITORS MATCHED PER P00347730.
(C) INDICATED CAPACITORS MATCHED PER P00347731.
(D) INDICATED DIODES MATCHED PER P00347301.
(E) INDICATED RESISTORS MATCHED WITHIN 30Ω.

CURRENT CONTROL

INTEGRATOR

FOLLOW AMP

OFFSET

OUTPUT AMPLIFIER

WAVEFORM SWITCH S3

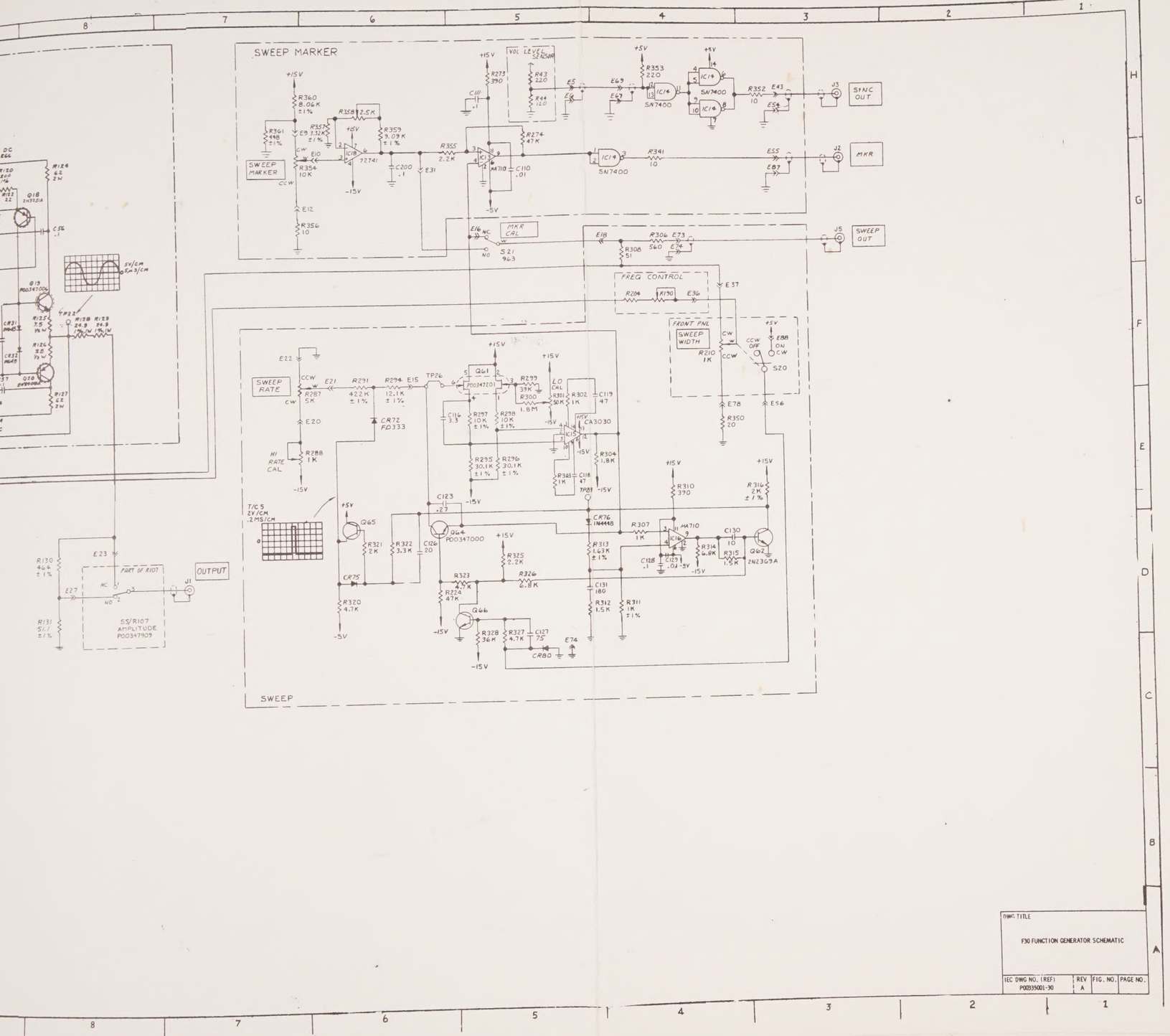
FREQ. ANALOG

VOLTAGE LEVEL SENSOR

SINE SHAPER

FREQ CONTROL

POWER SUPPLY




DWG TITLE

F30 FUNCTION GENERATOR SCHEMATIC

| IEC DWG NO. (REF) | REV | FIG. NO. | PAGE NO. |
|---|---|---|---|
| P00335001-30 | A | | |